

SCOPE OF MANUAL

This manual contains information concerning the installation, operation and maintenance of the Series 4500 Compu-Sonic flow meter. To ensure proper performance of the meter, the instructions given in this manual should be thoroughly understood and followed.

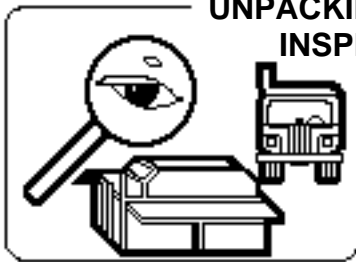
Keep the manual in a readily accessible location for future reference.

Changes and additions to the original edition of this manual will be covered by a "CHANGE NOTICE" supplied with the manual.

MODEL 4500 COMPU-SONIC TABLE OF CONTENTS

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UNPACKING & INSPECTION



To avoid damage in transit, Eastech Badger products are shipped to the customer in special shipping containers. Upon receipt of the product, perform the following unpacking and inspection procedures:

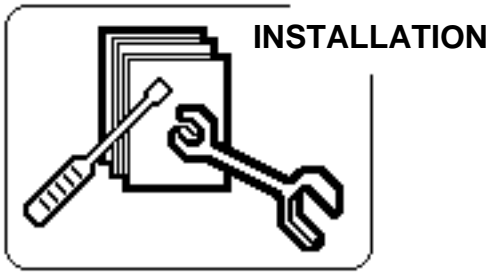
NOTE: If damage to the shipping container is evident upon receipt, request the carrier to be present when the product is unpacked.

a. Carefully open the shipping container following any instructions that may be marked on the box. Remove all cushioning material surrounding the product and carefully lift the product from the container.

Retain the container and all packing material for possible use in reshipment or storage.

b. Visually inspect the product and applicable accessories for any physical damage such as scratches, loose or broken parts, or any other sign of damage that may have occurred during shipment.

NOTE: If damage is found, request an inspection by the carrier's agent within 48 hours of delivery and file a claim with the carrier. A claim for equipment damage in transit is the sole responsibility of the customer.



ELECTRONIC ENCLOSURE

The Series 4500 electronics is housed in a rugged, NEMA 4X rated, polycarbonate enclosure which can be wall mounted. Supplied with each unit are two 1/4-20 x 3/4 inch mounting screws for use with lead inserts, two 1/4-20 x 3/4 inch sheet metal screws for other wall materials, and two "O" rings necessary to maintain the NEMA 4X rating of the enclosure.

When mounting the Series 4500 electronics, select a location that has good ventilation, temperature within the meter's specification, not in direct sunlight, not subject to flooding, protection from accidental shock, and provides accessibility to operate and service the meter.

ENCLOSURE MOUNTING

To mount the enclosure, using the 5/32 inch Allen wrench supplied in the mounting hardware package, loosen and remove all four hex bolts in the front of the housing (see Figure 2-1). Separate the front and back housings. **CAUTION: THERE ARE TWO SIGNAL WIRES ON THE FRONT HOUSING AND A RIBBON CABLE ON THE POWER SUPPLY BOARD THAT WILL NEED TO BE DISCONNECTED WHEN REMOVING THE FRONT HOUSING (SEE FIGURE 2-2).** Place the front housing in a protected area so it will not be damaged while mounting the back housing.

To mount the back housing, drill two holes in the wall 4.5 inches apart (centerline to centerline, see Figure 2-3). The size of the holes will depend on whether lead inserts are used or the mounting screws are screwed directly in the wall. Select the appropriate screws and place the "O" rings on the screws. With a 3/8 inch hex head driver, secure the back housing to the wall. **Since the power supply board is in the back housing, care should be taken to prevent damaging any components on the board.**

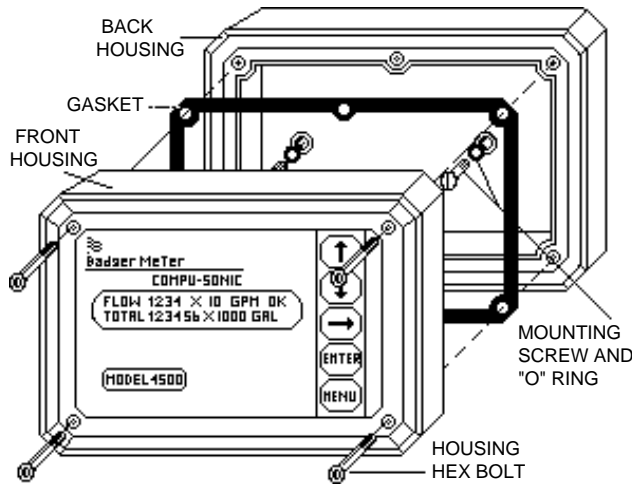


FIGURE 2-1

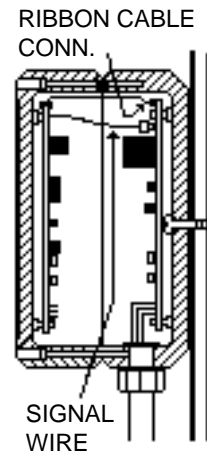


FIGURE 2-2

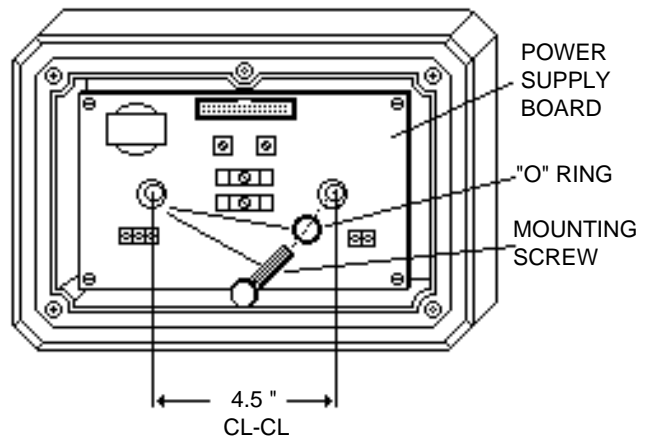


FIGURE 2-3

WIRING CONNECTIONS

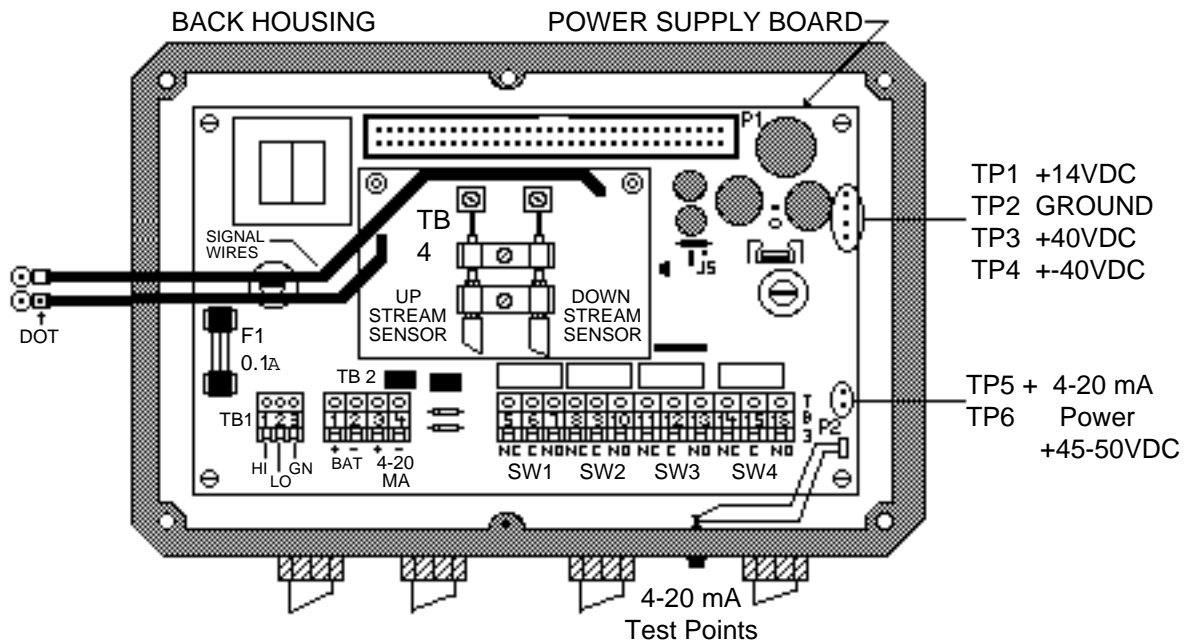
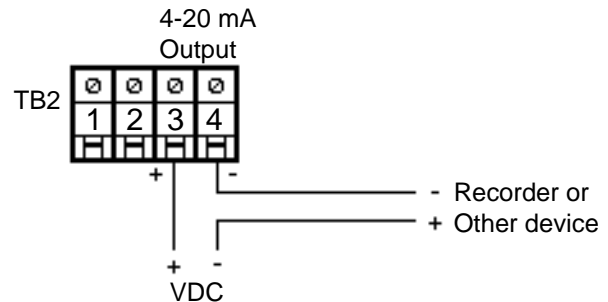
The Series 4500 electronics enclosure is provided with three holes for 1/2 inch NPT conduit fittings. These holes are on the bottom of the back housing of the enclosure and allow entry for the 115 or 230 VAC power wires, sensor cables and 4-20 mA signal output wires. **The AC power lines as well as the sensor cables must be in separate metallic conduits or the operation of the meter could be affected.**

The terminals on the power supply board will accept 14 to 22 gauge wire. A small common screw driver will be required to loosen and tighten the screws. The connectors snap off the board to facilitate the inserting of the wires easier.

Power supply connections (Figure 2-4). Terminal connector TB1 is for the 115 VAC connections. Terminal 1 is the high side (black wire) connection. Terminal 2 is the low or neutral side (white wire) connection. Terminal 3 is the earth ground (green wire) connection.

Terminal connector TB2 is for the 12 VDC external battery power connections and the 4-20 mA output. Terminal 1 is the positive (+) connection and Terminal 2 is the negative (-) connection for the battery (12 VDC) power input. The voltage range for this input is 9 VDC to 14 VDC. This input will operate the meter but not the 4-20 mA output. Terminals 3 and 4 of TB2 are for the 4-20 mA output. Terminal 3 is the positive (+) connection and Terminal 4 is the negative (-) connection. The maximum load resistance when operating the meter with AC power is 1000 ohms.

To power the 4-20 mA output when operating with DC power, the DC power must be connected in series with the load (recorder) as shown below.



**FIGURE 2-4
BACK HOUSING POWER SUPPLY**

The size of the DC supply will depend on the load resistance the 4-20 mA is driving. It requires 8 VDC to power the 4-20 mA circuitry. The equation to determine the required voltage for a load is:

$$V = (R * .02) + 8$$

where:

V = Power supply in VDC

R = Resistance of load in ohms

For example, if the device connected to the 4-20 mA output has a resistance of 250 ohms, then the required power supply is 13 VDC.

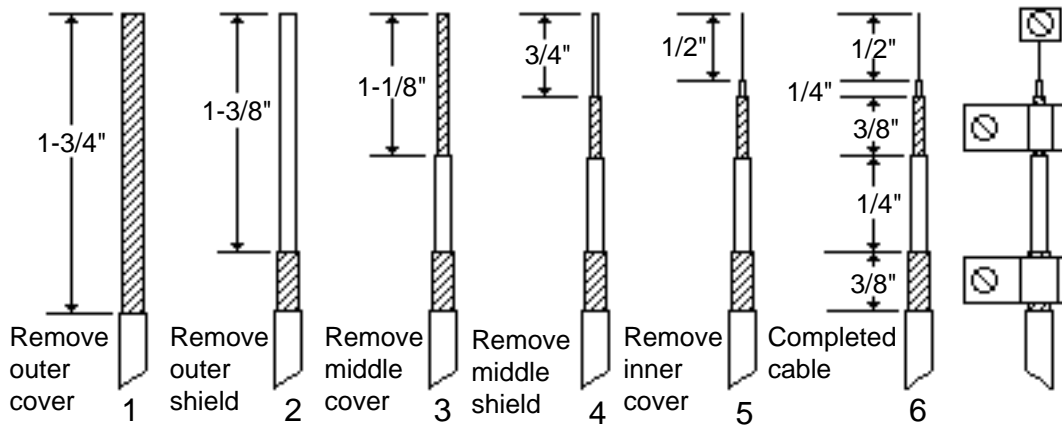
$$V = (250 * .02) + 8$$

$$V = 13 \text{ VDC}$$

The terminal strip TB3 has the connections for the four relay outputs. These are labeled SW1 through SW4 and represent relays 1 through 4 respectively. These relays are SPDP and are rated for 1 amp at 24 VDC or 0.5 amp at 120 VAC.

The output of these relays will depend on the assignment given to them in the Calibration Mode. Refer to Page 4-7 for further details regarding the assignment of specific functions to the relays.

There are two test point jacks on the bottom of the case between the third and fourth conduit holes. These allow the checking of the 4-20 mA output with a current meter. A load must be connected to the 4-20 mA output terminals. **Do not use these jacks as a second 4-20 mA output or the normal output will be affected.**



**FIGURE 2-5
SENSOR CABLE PREPARATION**

Sensor cable connections. Before pulling the sensor cables through the conduit, mark the ends of the cables to indicate which is the upstream and downstream sensor cable. Leave approximately 8 inches of cable extending from the conduit in the enclosure. Refer to Figure 2-5 and prepare the cable ends in the following manner.

1. Remove outer cable cover. Measure 1-3/4" from the end of the cable. With a cutting tool, carefully cut through the outer covering completely around the cable making sure not to cut into the outer shield. Make another cut from the first cut to the end of the cable and remove the outer cover.

2. Remove outer shield. Measure 1-3/8" from the end

of the cable with a pair of small cutters, cut the shield around the cable at the measured point and remove the cut off shield.

3. Remove middle cover. Measure 1-1/8" from the end of the cable. With a cutting tool, carefully cut through the middle covering completely around the cable making sure not to cut into the middle shield. Make another cut from the first cut to the end of the cable and remove the middle cover.

4. Remove middle shield. Measure 3/4" from the end of the cable. With a pair of small cutters, cut the shield around the cable at the measured point and remove the cut off shield.

5. Remove inner cover. Measure 1/2" from the end of the cable. With a cutting tool or pair of wire strippers, carefully cut the inner covering completely around the cable, making sure not to cut into the center conductor and remove the inner cover.

After the ends of the cables have been prepared, loosen the screws on Terminals 1 and 2 of TB4 on the back housing power supply and remove the two pairs of clamps below TB4. Take the upstream cable and insert the center conductor into Terminal 1 and tighten the screw. Slightly pull on the cable to ensure the wire is secured to the terminal. Take the downstream cable and insert the center conductor into Terminal 2 and tighten the screw. Slightly pull on the cable to ensure the wire is secured to the terminal.

Place the two pair of clamps over the middle and outer shields and secure them into place. Verify that the clamps are making good contact with the shields and that no wires of the shields are extending beyond their own clamp down area.

Front housing installation. After the wiring of the back housing is completed, the front housing can be reinstalled. The gasket is attached to the front housing to ensure proper alignment for maintaining a good seal.

Refer to Figure 2-6. On the front housing there is a protective cover for the electronic boards that also has the drawing for the wiring connections of the unit. Connect the ribbon cable plug S1 coming from the front housing into the socket connector P1 on the power supply in the back housing.

Insert the two signal wires coming from the power supply board in the back housing into the connectors on the electronic board in the front housing. One of the signal wires has a white dot marked on it and should be inserted into the connector next to the dot indicated on the protective cover drawing. Secure the front housing to the back housing with the four hex bolts.

Page 2-6 shows the wiring for the Series 4500 mounted in the 3000+ recorder and in an outdoor enclosure with heater and thermostat.

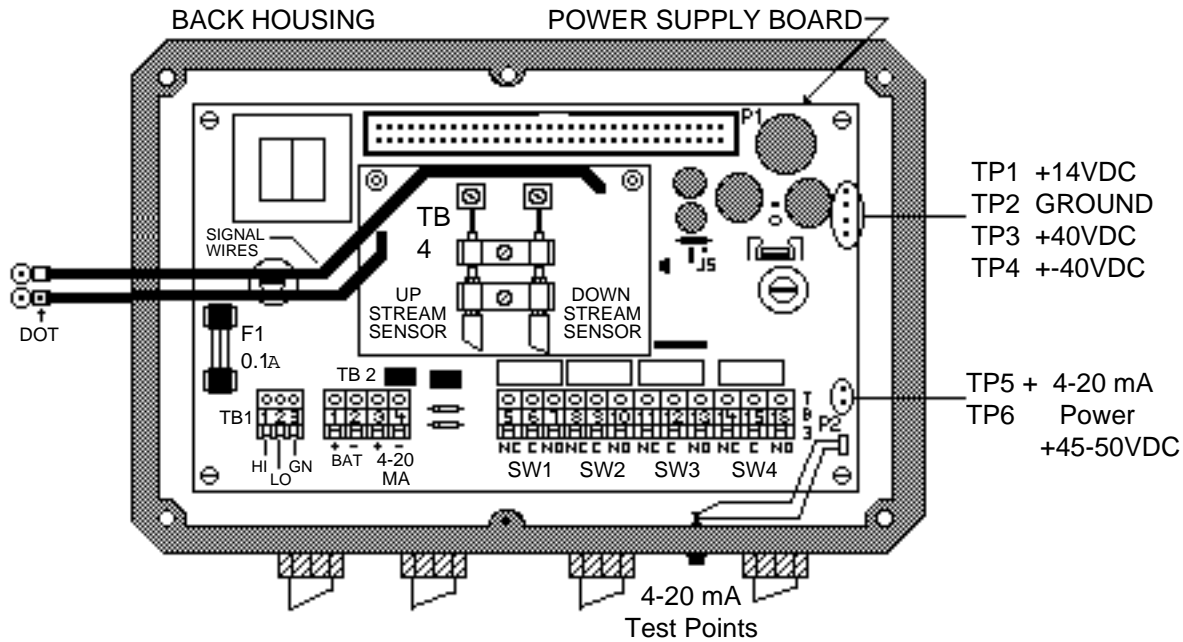
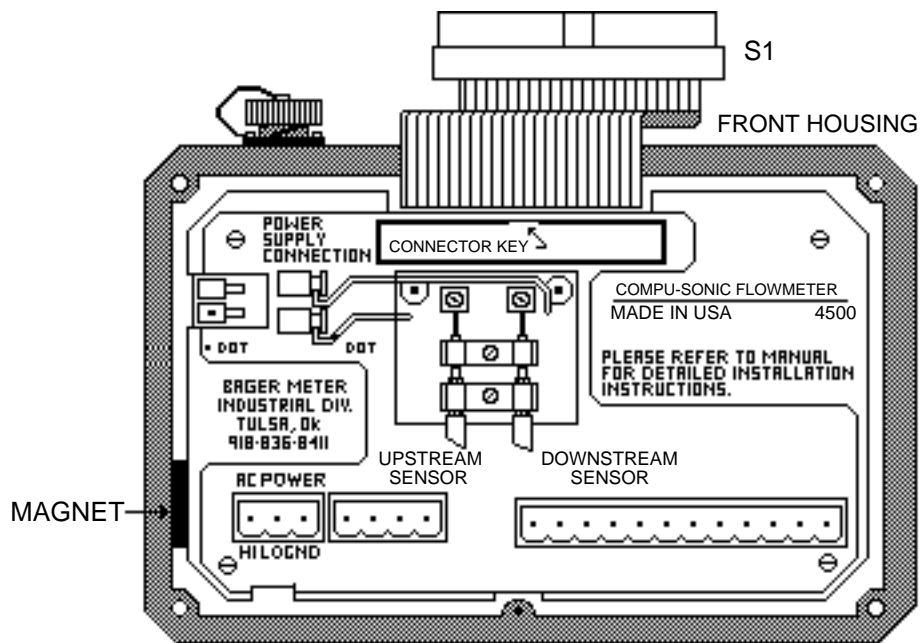


FIGURE 2-6

117VAC FROM CUSTOMER TERMINAL TO 4500
AND RECORDER TERMINALS AND 4-20 MADC
SIGNAL FROM 4500 TO RECORDER ARE PRE-WIRED
AT THE FACTORY

RECORDER ACCESSORY OUTPUTS
SEE RECORDER MANUAL PG. 4

UPSTREAM &
DOWNSTREAM
SENSOR TERMINATION
(SEE MANUAL PG. 2-3
& 2-4)

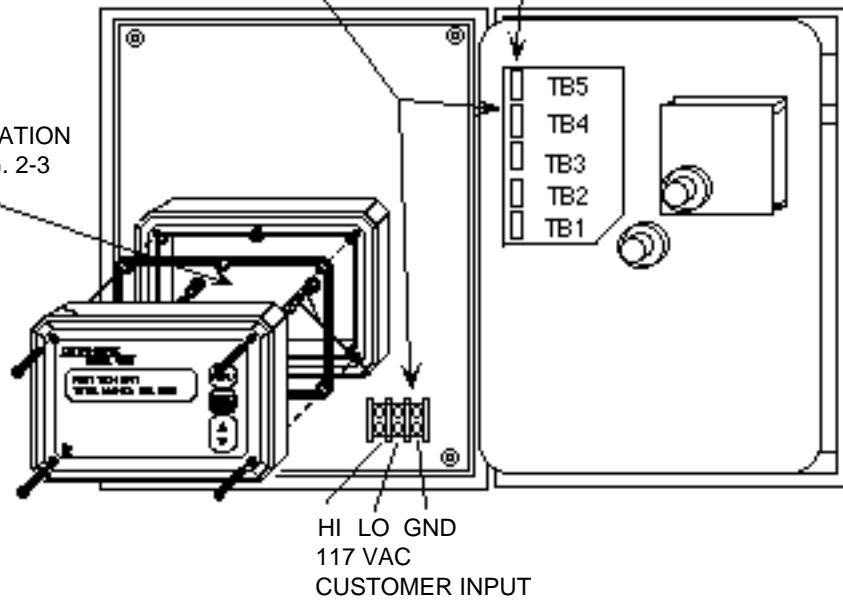


FIGURE 2-7
SERIES 4500 IN 3000+ RECORDER
WIRING DIAGRAM

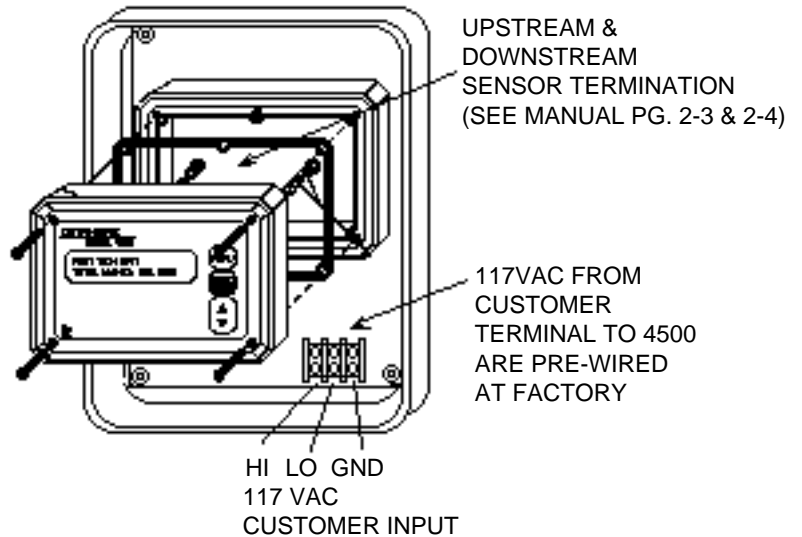
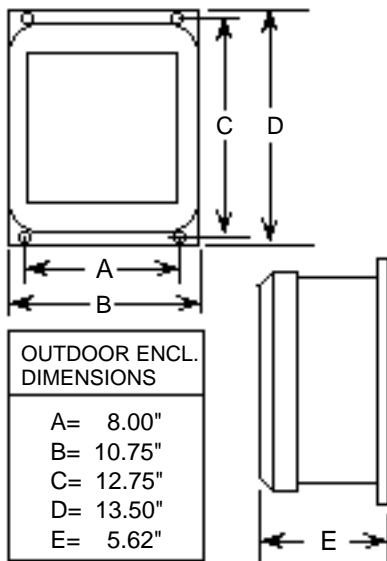


FIGURE 2-8
SERIES 4500 OUTDOOR ENCLOSURE
WIRING DIAGRAM

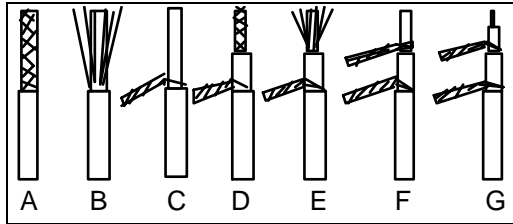
TRIAx CABLE SPLICE PROCEDURE

Materials Required

- * 4 pigtail cap crimps (wire size 18-12)
- * 2 center conductor cap crimps (wire size 22-14)
- * 1 roll of electrical tape
- * 2 epoxy resin envelopes
- Crimp tool (customer supplied)
- Knife (customer supplied)
- Pointed tool (customer supplied)
- Junction box (customer supplied)

A cable connection kit may be purchased through Eastech Badger that will include the * items above (Part # 541874).

Trim each of the four cables at the junction box to 9 inches in length. Each of the four cables can now be prepared as described in the sequence following:



Using a knife, trim two inches of the outer jacket from each cable. The wire braid beneath the outer jacket must not be cut. See "A".

Using a pointed tool, carefully comb out the outer braid of each cable as shown in "B". Form the combed braid into a pigtail dressed to the side of the cable as shown in "C".

Trim 1 inch of the inner jacket from each of the cables as shown in "D". Again, use care not to cut the inner braid beneath the inner jacket.

Using a pointed tool, carefully comb out the inner braid "E" and form into a pigtail dressed to the same side of the cable as outer pigtail in "F".

Remove 1/2 inch of insulation from the inner conductor of each cable. Cut the outer pigtail to the same length as the inner pigtail on each cable. "G" depicts the completed preparation.

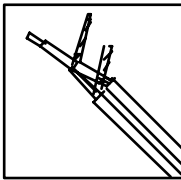


FIG 1

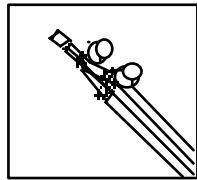


FIG 2

Cable Termination

Pull cables approximately 18 inches outside of junction box. Select one sensor cable and one cable from the electronic enclosure and place them side by side as shown in Fig. 1. Twist each cable's outer pigtails together, then the inner pigtails together and finally the center conductors together to form the cable splice. In similar fashion, connect the remaining sensor cable and the cable from the electronic enclosure.

Identification of upstream and downstream sensor cables must now be made. Connect a short wire from the center conductor splice to the inner shield pigtail splice on the upstream sensor cable. Using a multimeter determine the upstream

sensor cable at the electronic enclosure end by continuity measurement. Identify the upstream cable for later termination.

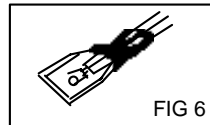
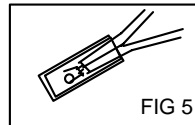
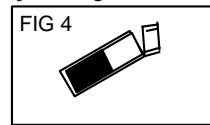
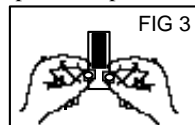
Remove the shorting wire and using the cap crimps supplied, crimp the larger caps on each spliced pigtail and the small cap on the center conductor splice as shown in Fig. 2. Repeat this procedure for the second cable.

At this point turn power on at the electronics and verify that an OK signal condition appears on the display.

Turn power "OFF".

Using Scotchlok Sealer

1. Read caution statement at bottom.
2. Remove guard bag, using caution not to damage inner bag.
3. Grip both edges of bag at the center barrier (Fig. 3) and wrinkle and flex the bag across the barrier. This will weaken the barrier.
4. Squeeze the clear side of the resin, forcing the resin through the center barrier.
5. Mix thoroughly to a uniform color by squeezing contents back and forth 24-30 times.
6. Squeeze resin to one end of bag, and cut off the other end (Fig. 4).
7. Slowly insert connection into sealing pack until it fits snugly against the opposite end (Fig. 5).
8. Wrap open end of bag with vinyl electrical tape and position the taped end up until resin jells (Fig. 6).



The finished splices should be coiled inside the junction box. When properly placed, the splices should be clear of the junction box cover area. Proper sealing of the junction box is necessary for watertight integrity.

This completes the triax cable splice connection.

The sealer kit above is a 3M Scotchlok #3570 product IRRITATING TO SKIN AND EYES ON DIRECT CONTACT

May cause skin sensitization in susceptible individuals. May be toxic by skin absorption.

Harmful if swallowed. Vinyl cyclohexene dioxide has caused skin cancer in animal tests.

Contains epoxy resin and vinyl cyclohexene dioxide.

Avoid skin and eye contact. Use only in well-ventilated areas with sufficient air movement to maintain airborne vapor levels at recognized health and safety levels. Wash thoroughly after using, before eating, drinking or smoking.

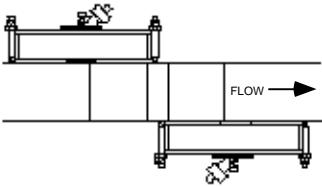
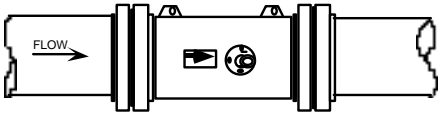
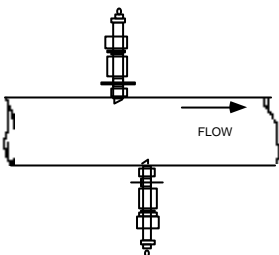
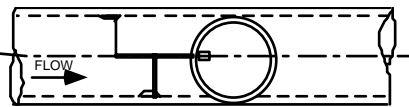
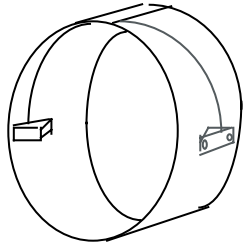
EYE CONTACT: Immediately flush eyes with water for at least ten minutes. Call physician.

SKIN CONTACT: Wash with soap and water. **INHALATION:** Provide fresh air.

SECTION 3 - SENSOR INSTALLATION

This section includes installation for the various sensors used with the Series 4500 ultrasonic flow meter. Refer to

the Customer Data Sheet in the front of this manual to determine the type of sensors that are supplied.

SENSOR TYPE	PAGE	
V-SHOT STRAP-ON	3-3	
Z-SHOT STRAP-ON	3-4 THRU 3-9	 <p>The diagram shows a cross-section of a pipe with a Z-shot sensor installed. The sensor is mounted on the top and bottom of the pipe. An arrow labeled 'FLOW' indicates the direction of flow from left to right through the pipe.</p>
2" STRAP-ON	3-10	
HI-TEMP STRAP-ON	3-11	
WINDOWED SPOOL	3-12	 <p>The diagram shows a spool with a windowed section. The sensor is mounted on the window. An arrow labeled 'FLOW' indicates the direction of flow from left to right through the spool.</p>
HS3 "HOTSHOT" SENSOR	3-13 THRU 3-15	 <p>The diagram shows a pipe with two sensors mounted on the top and bottom. An arrow labeled 'FLOW' indicates the direction of flow from left to right through the pipe.</p>
INSTREAM REFRACTING SENSOR	3-16	 <p>The diagram shows a pipe with an instream refracting sensor. The sensor is mounted inside the pipe. An arrow labeled 'FLOW' indicates the direction of flow from left to right through the pipe.</p>
WETTED SENSOR WITH HOOP	3-17 THRU 3-18	 <p>The diagram shows a circular hoop with a sensor mounted on it. The sensor is positioned to measure flow through the hoop.</p>

STRAP-ON SENSORS

The strap-on sensors for the Series 4500 are designed for external mounting on pipes made of material, such as steel or plastics, that will support ultrasonic signal transmissions. The mounting hardware is constructed of corrosion resistant materials and designed for ease of installation.

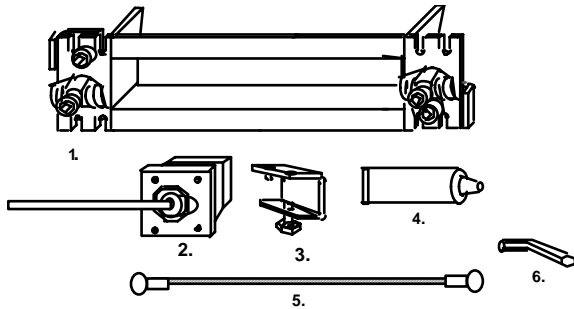
It is important that the sensors are installed correctly on the pipe to ensure good accuracy. A template is provided for positioning the sensor holders on the pipe. The proper configuration for your application is indicated on the data sheet in the front of this manual. When properly installed,

the sensors will be located 180 degrees apart on opposite sides of the pipe and be offset upstream and downstream by the distance on the Data Sheet in the front of this manual. The sensors may be mounted on horizontal or vertical pipe runs. **If the pipe is horizontal, the sensors must be located on the sides and not on the top and bottom.**

It is important that there be as much upstream straight run as possible so there will be a well developed velocity profile at the point of measurement. There should be 3 pipe diameters of downstream straight run after the point of measurement.

WIDTH	MOUNTING CONFIGURATION
7"	Case B & C
14"	Case D
21"	Case E
28"	Case F
35"	Case G
42"	Case H
49"	Case I
56"	Case J

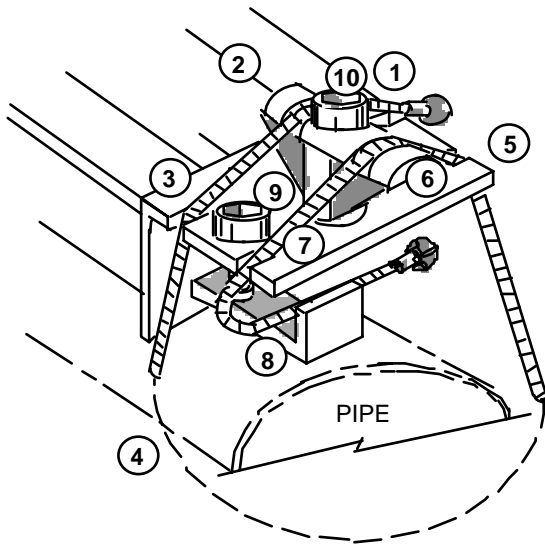
SERIES 4000 V-SHOT INSTALLATION



ITEM	DESCRIPTION	QTY
1.	SENSOR HOLDER 304 S/S	1
2.	SENSOR W/100 FT. CABLE	2
3.	SENSOR CLAMP & 7/16 HEX HEAD SCREW	4
4.	SILICONE (FOR SENSORS)	1
5.	WIRE ROPE 1/8" DIA. (CUT PER ORDER)	2
6.	ALLEN WRENCH	1

NOTE: Pipe preparation before installation. It may be necessary, particularly with Cast Iron or Ductile Iron pipe, to sand pipe to a smooth and radial surface where the sensors are to be placed.

Place the probe holder (1) on the top of the pipe.



WRAPPING THE CABLE

1. Place one end of the stainless steel cable through the slot closest to the rail and opposite of the clamp side.
2. Pull cable over the groove in the tension holder (9).
3. Pull cable through the slot on the holder.
4. Wrap cable completely around the pipe.
5. Pull cable through the slot on the holder.
6. Pull cable over the groove in the tension holder (9).
7. Pull cable through the slot on the holder.
8. Loosen the cable clamp with the socket head screw. Slide the cable between the probe holder and the cable clamp. Pull the excess cable through the clamp.
9. Tighten the socket head screw.

Repeat the above instructions for the other end of the probe holder and cable.

Slide the probe holder down to the side of the pipe.

10. Use the Allen wrench and turn the tension holder screw (10) counterclockwise until the probe holder is tight against the pipe.

Place a single bead of silicone grease (4) longitudinally along the PVC face of the sensor. Slide sensor (2) into sensor holder (1), note that the sensor cable (yellow) will be pointing toward the other sensor (Fig. 3). Use sensor clamp (3) and place the top over the sensor with knobs in sensor hole and place the bottom of the clamp on the bottom of the rail of the sensor holder. (See A-A detail)

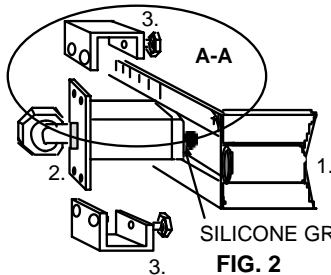
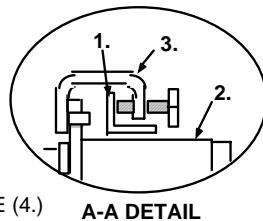


FIG. 2



A-A DETAIL

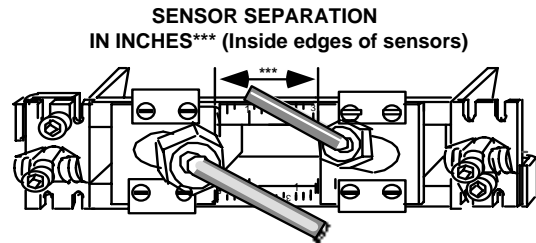
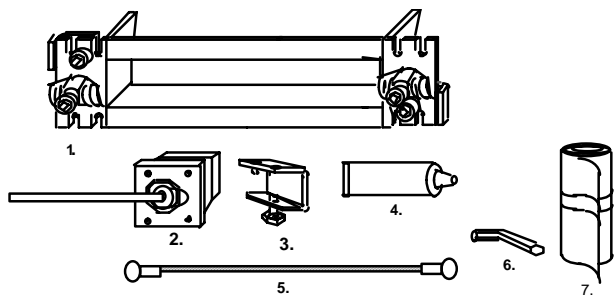


FIG. 3

See Data Sheet in front of customer IOM manual. Locate on Page 2 of Data Sheet Sensor Style Section. The Sensor Offset in inches will be displayed as "Offset #.### Inches". The offset in inches is the separation to be used on the top ruler on the probe holder. Align Top right edge of the left hand sensor on the "0" on the top ruler on the sensor holder. Move the right hand sensor to the sensor separation in inches using the upper left edge of the right hand sensor to the Offset distance. Tighten hex head screws on the sensor clamp (3) snugly to the sensor holder with Hex wrench. See IOM manual for cable termination at electronics.

SERIES 4000 Z STRAP-ON SENSOR INSTALLATION (CASE B)



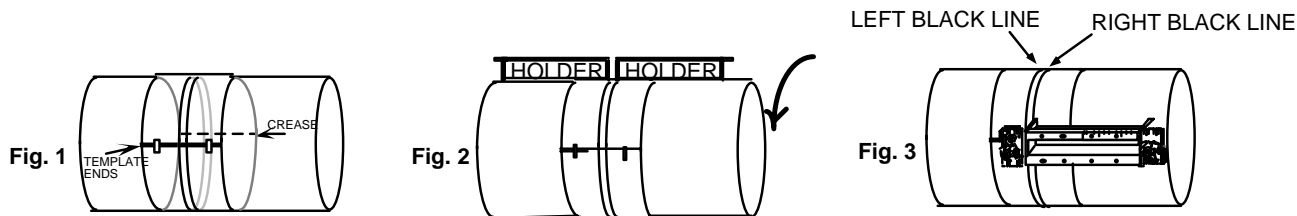
ITEM	DESCRIPTION	QTY
1.	SENSOR HOLDER 304 S/S	2
2.	SENSOR W/100 FT. CABLE	2
3.	SENSOR CLAMP & 7/16 HEX HEAD SCREW	4
4.	SILICONE (FOR SENSORS)	1
5.	WIRE ROPE 1/8" DIA. (CUT PER ORDER)	4
6.	ALLEN WRENCH	1
7.	MYLAR TEMPLATE	1

NOTE: Pipe preparation before installation. It may be necessary, particularly with Cast Iron or Ductile Iron pipe, to sand pipe to a smooth and radial surface where the sensors are to be placed. If pipe is Asbestos Cement place a coat of shellac over the surface where the sensors are to be mounted.

Using tape, attach one end of the template (7) to the pipe and wrap the rest of the template around the pipe. Pull the template straight and mark the point of overlap on the template. Cut off the excess.



Remove template from pipe. Fold template exactly in half and crease in the middle. Wrap the template around the pipe so that the crease is on one side of the pipe and the two ends of the template meet on the other side of the pipe. Try to line up the crease and ends with the horizontal center of the pipe. Tape the ends of the template together with masking tape to hold in place on the pipe (Fig. 1).



Place the probe holders (1) on the top of the pipe. The probe holder on the right hand side should have the ruler on the upper right corner and should be lined up with the right black line in the middle of the template (Fig. 2 & 3). The probe holder on the left should be upside down and have the ruler on the lower left corner and should be lined up with the left black line in the middle of the template (Fig. 2 & 3).

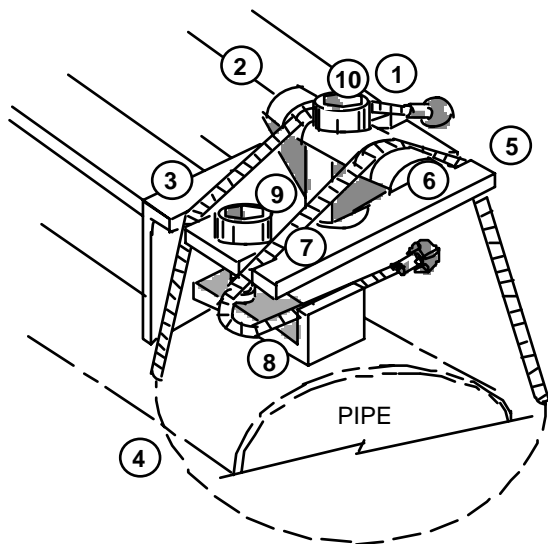
WRAPPING THE CABLE

1. Place one end of the stainless steel cable through the slot closest to the rail and opposite of the clamp side.
2. Pull cable over the groove in the tension holder (9).
3. Pull cable through the slot on the holder.
4. Wrap cable completely around the pipe.
5. Pull cable through the slot on the holder.
6. Pull cable over the groove in the tension holder (9).
7. Pull cable through the slot on the holder.
8. Loosen the cable clamp with the socket head screw. Slide the cable between the probe holder and the cable clamp. Pull the excess cable through the clamp.
9. Tighten the socket head screw.

Repeat the above instructions for the other end of the probe holder and cable.

Slide the probe holder down to the side of the pipe. Align the center on the holder to the template fold and the ends.

10. Use the Allen wrench and turn the tension holder screw (10) counterclockwise until the probe holder is tight against the pipe.



Place a single bead of silicone grease (4) longitudinally along the PVC face of the sensor. Slide sensor (2) into sensor holder (1), note that the sensor cable (yellow) will be pointing toward the other sensor (Fig. 4). Use sensor clamp (3) and place the top over the sensor with nubs in sensor hole and place the bottom of the clamp on the bottom of the rail of the sensor holder. (See A-A detail)

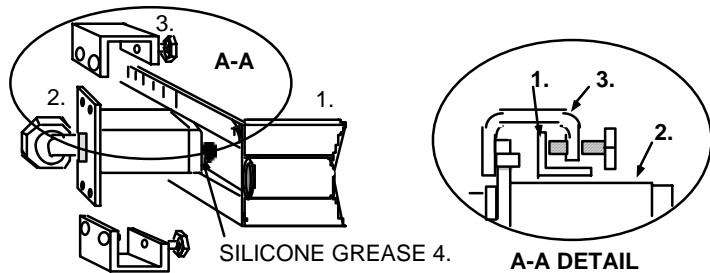


FIG. 4

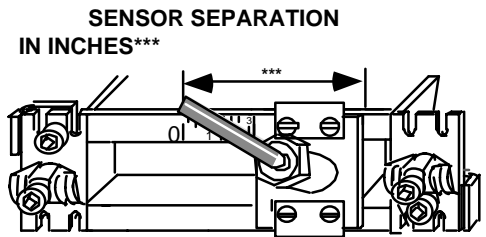
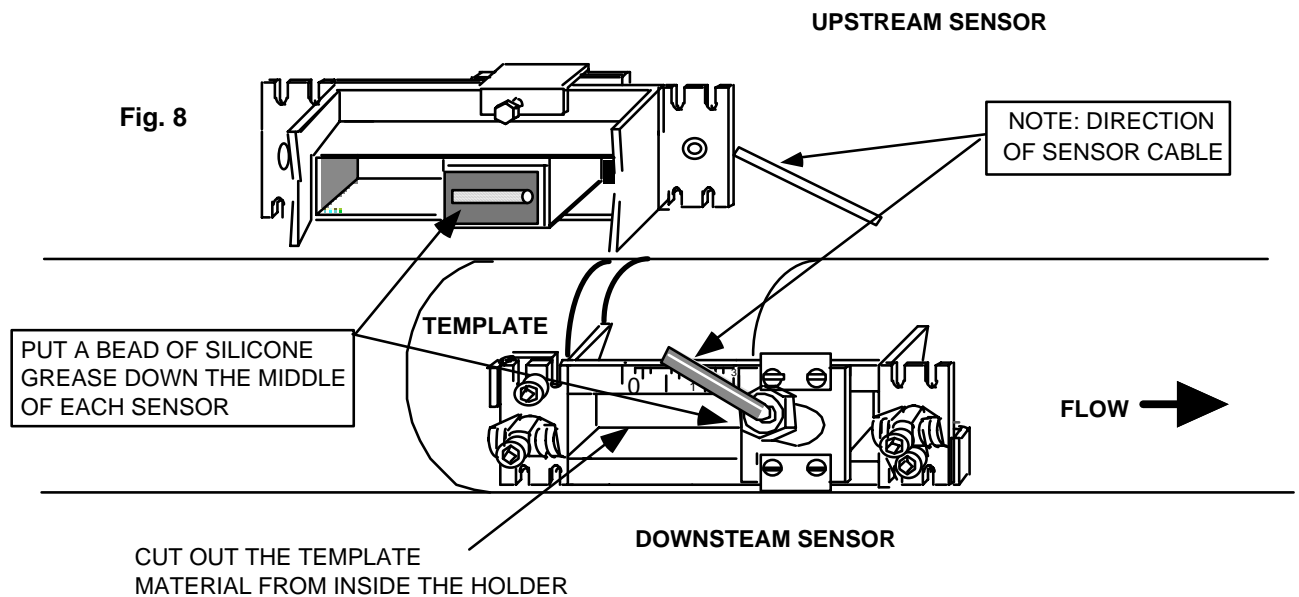
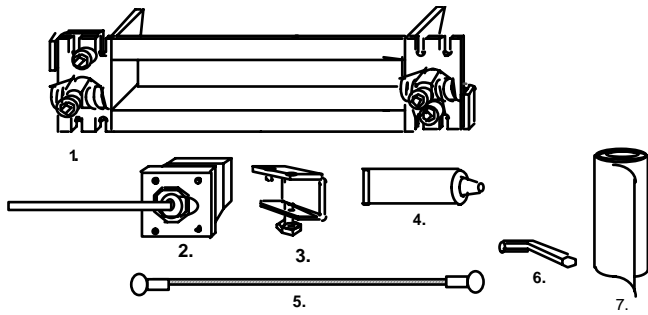


FIG. 5

See Data Sheet in front of customer IOM manual. Locate on Page 2 of Data Sheet Sensor Style Section. The Sensor Offset in inches will be displayed as “Case-B Offset #.### Inches”. The offset in inches is the separation toe used on the top ruler on the probe holder. Align right edges of the sensors on the “0” on the rulers on both sensor holders. Either move one sensor to the sensor offset using the right edge of the sensor, or divide Offset by 2 and move both sensors 1/2 the Offset distance. Tighten screw on the sensor clamp (3) with the wrench. See IOM manual for cable termination at electronics.



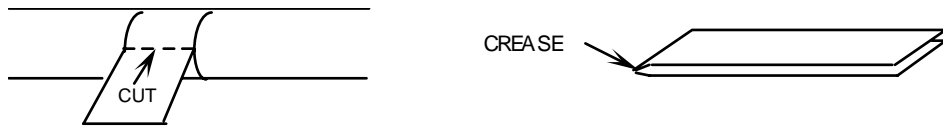
SERIES 4000 Z STRAP-ON SENSOR INSTALLATION (CASE C THRU J)



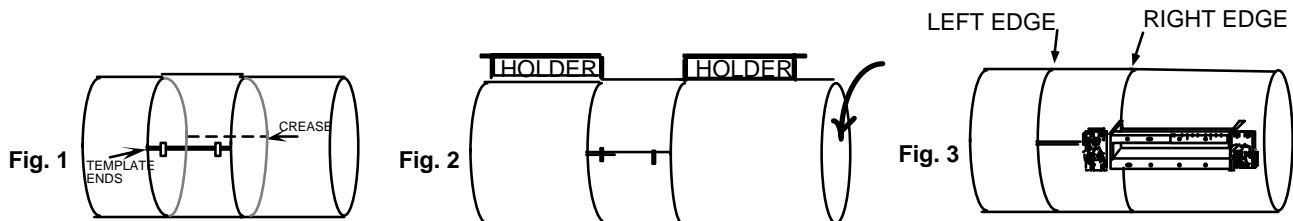
ITEM	DESCRIPTION	QTY
1.	SENSOR HOLDER 304 S/S	2
2.	SENSOR W/100 FT. CABLE	2
3.	SENSOR CLAMP & 7/16 HEX HEAD SCREW	4
4.	SILICONE (FOR SENSORS)	1
5.	WIRE ROPE 1/8" DIA. (CUT PER ORDER)	4
6.	ALLEN WRENCH	1
7.	MYLAR TEMPLATE	1

NOTE: Pipe preparation before installation. It may be necessary, particularly with Cast Iron or Ductile Iron pipe, to sand pipe to a smooth and radial surface where the sensors are to be placed. If pipe is Asbestos Cement place a coat of shellac over the surface where the sensors are to be mounted.

Using tape, attach one end of the template (7) to the pipe and wrap the rest of the template around the pipe. Pull the template straight and mark the point of overlap on the template. Cut off the excess.



Remove the template from pipe. Fold template exactly in half and crease in the middle. Wrap the template around the pipe so that the crease is on one side of the pipe and the two ends of the template meet on the other side of the pipe. Try to line up the crease and ends with the horizontal center of the pipe. Tape the ends of the template together with masking tape to hold in place on the pipe (Fig. 1).



Place the probe holders (1) on the top of the pipe. The probe holder on the right hand side should have the ruler on the upper right corner and should be lined up with the right edge of the template (Fig. 2 and 3). The probe holder on the left should be upside down and have the ruler on the lower left corner and should be lined up with the left edge of the template (Fig. 2 & 3).

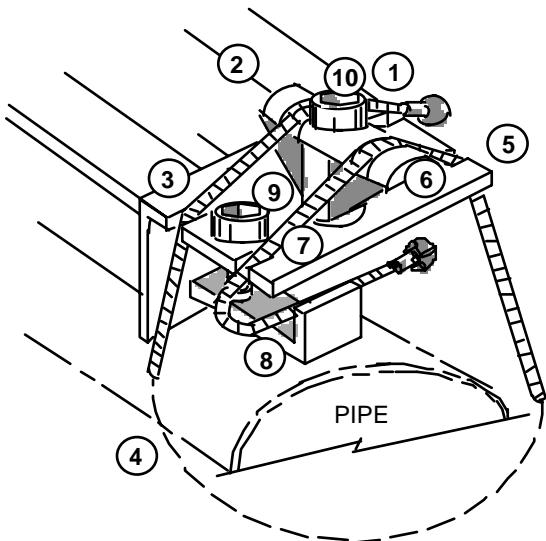
WRAPPING THE CABLE

1. Place one end of the stainless steel cable through the slot closest to the rail and opposite of the clamp side.
2. Pull cable over the groove in the tension holder (9).
3. Pull cable through the slot on the holder.
4. Wrap cable completely around the pipe.
5. Pull cable through the slot on the holder.
6. Pull cable over the groove in the tension holder (9).
7. Pull cable through the slot on the holder.
8. Loosen the cable clamp with the socket head screw. Slide the cable between the probe holder and the cable clamp. Pull the excess cable through the clamp.
9. Tighten the socket head screw.

Repeat the above instructions for the other end of the probe holder and cable.

Slide the probe holder down to the side of the pipe. Align the center of the holder to the template fold and the ends.

10. Use the Allen wrench and turn the tension holder screw (10) counterclockwise until the probe holder is tight against the pipe.



Place a single bead of silicone grease (4) longitudinally along the PVC face of the sensor. Slide sensor (2) into sensor holder (1), note that the sensor cable (yellow) will be pointing toward the other sensor (Fig. 4). Use sensor clamp (3) and place the top over the sensor with nubs in sensor holes and place the bottom of the clamp on the bottom of the rail of the sensor holder. (See A-A detail)

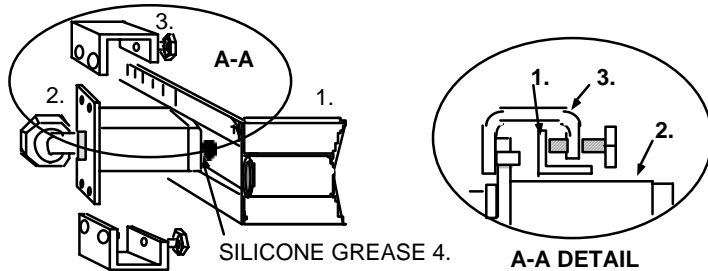


FIG. 4

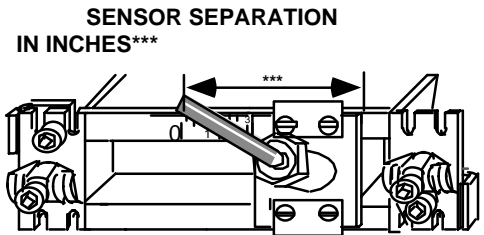
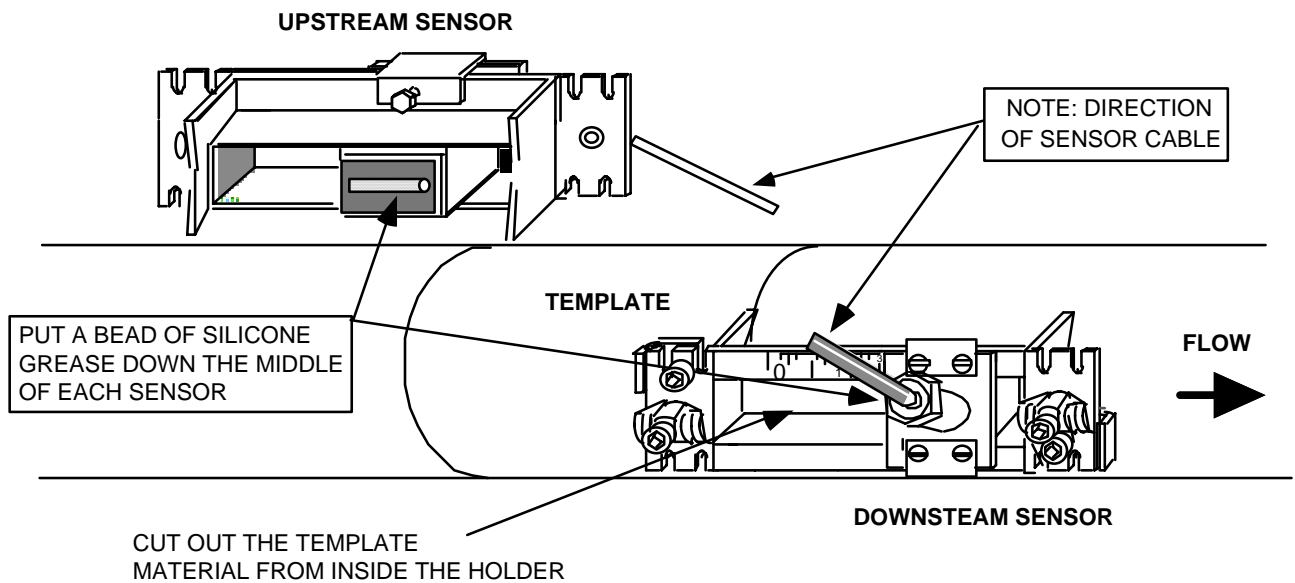
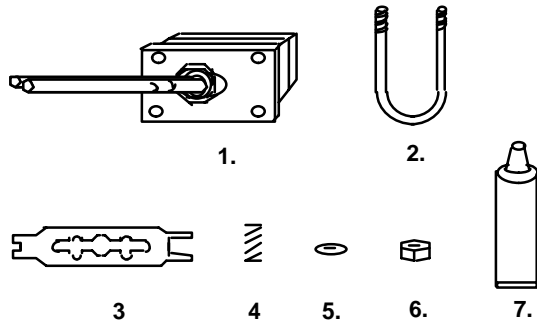


FIG. 5

See Data Sheet in front of customer IOM manual. Locate on Page 2 of Data Sheet Sensor Style Section. The Sensor Offset in inches will be displayed as “Case C-J Offset ###.### Inches”. The offset in inches is the separation to be used on the rulers on the probe holders. Align the right edges of sensors on the “0” on the rulers on both sensor holders. Either move one sensor to the sensor offset using the right edge of the sensor, or divide Offset by 2 and move both sensors 1/2 the Offset distance. Tighten screw on sensor clamp (3) with wrench. See IOM manual for cable termination at electronics.



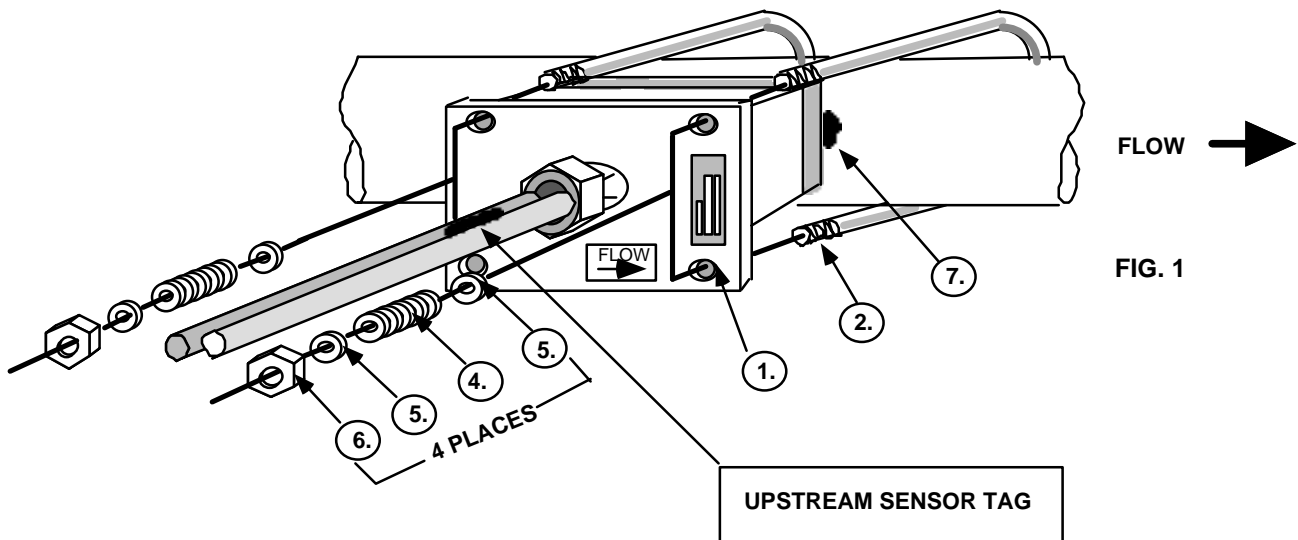
SERIES 4000 2 INCH SENSOR INSTALLATION



ITEM	DESCRIPTION	QTY
1.	SENSOR 2"	1
2.	U BOLT	2
3.	WRENCH 7/16 X 1/2	1
4.	SPRING	4
5.	FLAT WASHER	4
6.	NUT HEX 1/2-13 S/S	4
7.	SILICONE (FOR SENSORS)	1

NOTE: Pipe preparation before installation. It may be necessary to sand pipe to a smooth and radial surface where the sensors are to be placed.

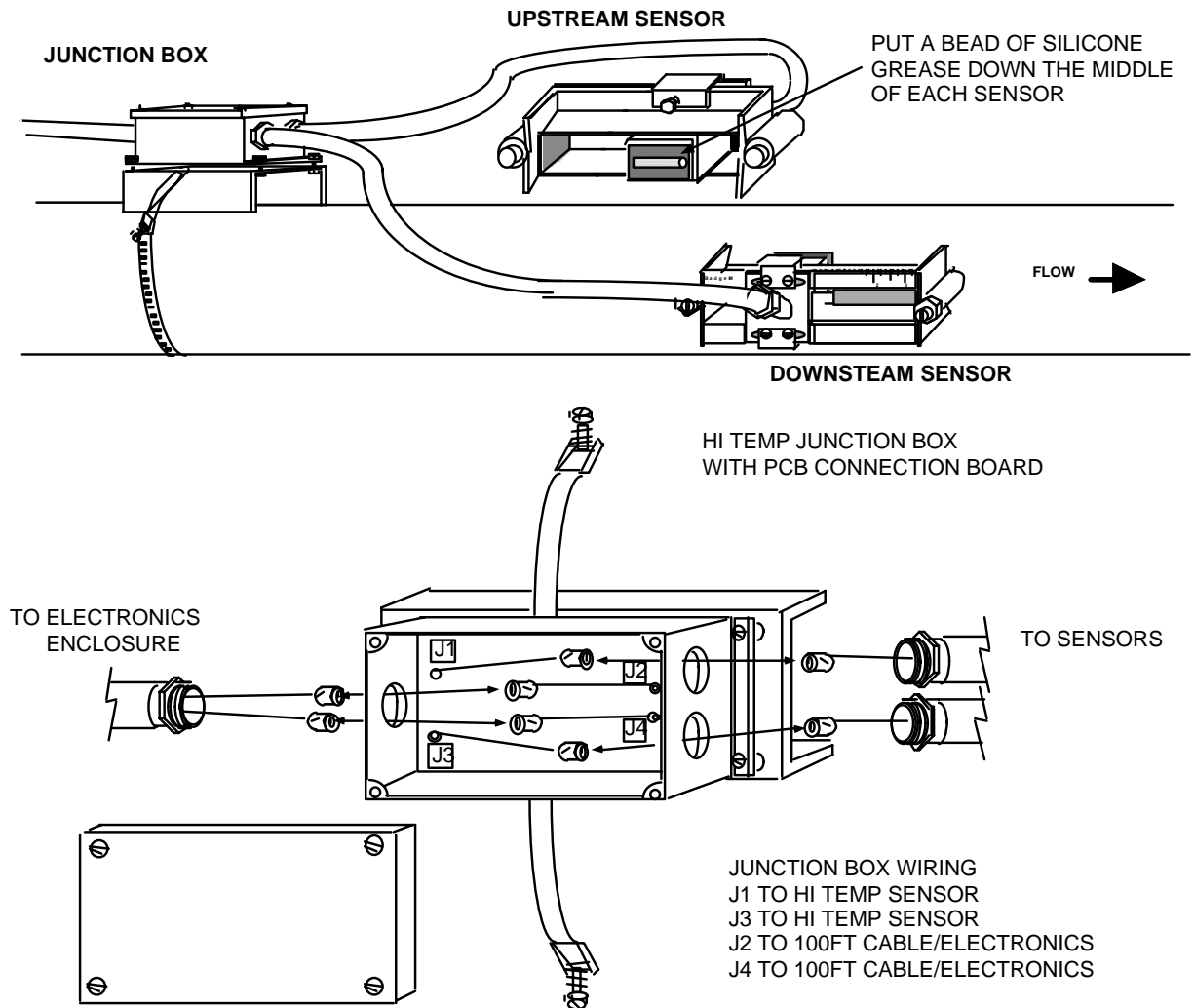
Place a single bead of silicon grease (7) longitudinally along the PVC face of the sensor. Locate the flow direction arrow on the sensor plate. Place sensor (1) onto the side of the pipe with the flow direction arrow pointing with the forward flow direction. Put one U-bolt (2) around the pipe through the holes on the sensor plate (Fig. 1). Place a flat washer (5), spring (4), and flat washer (5) over the two threaded ends of the U-bolt. Screw the nut (6) down snugly to the top flat washer. Place the other U-bolt around the pipe and through the other end of the sensor. Place washers, spring and nut as above.



Tape the end of the upstream sensor cable before running both cables through conduit. This will ease the termination of the cables at the electronics enclosure. The taped end is the upstream connection and the untaped end is the downstream connection. Tighten nuts (6) to compress the springs to approximately 0.75 inches with the wrench (3). See IOM manual for cable termination at electronics.

SERIES 4000 HI TEMP SENSOR INSTALLATION

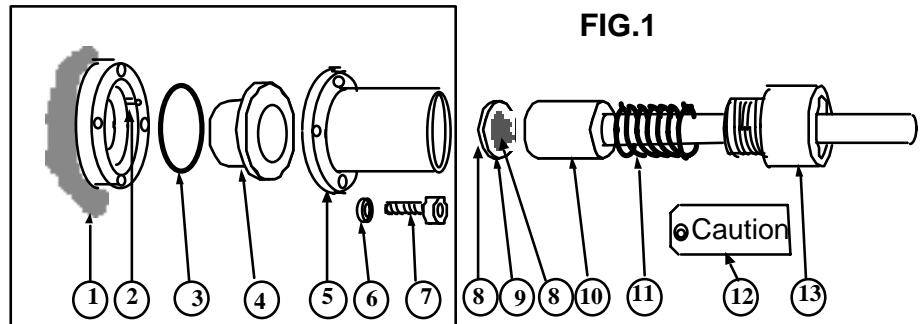
NOTE: FOLLOW SENSOR INSTALLATION INSTRUCTIONS FOR STYLE OF STRAP-ON SENSORS INDICATED ON DATA SHEET.



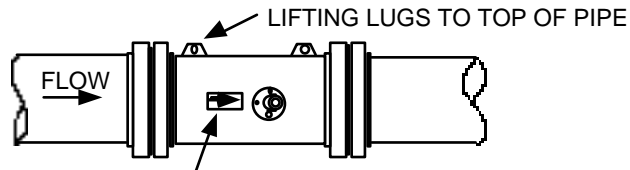
1. Place junction box on the top of the pipe orienting the two conduit hole side towards the mounted sensors.
2. Wrap stainless steel strap around the underneath side of the pipe and run each end through the snap lock screw on each end of the straps on the junction box. Lock one end of the snaplock onto the strap and pull the other end as tight as possible through the other snaplock before snapping onto the strap. Use a flat head screw driver and tighten the screw on the snap lock. This will tighten the strap around the pipe.
3. Place the conduit fittings from the flexible conduit from the sensors into the two holes provided in the junction box. Tighten the nuts onto the conduit fittings.
4. The BNC connectors from the sensors will be connected to the BNC connectors of J1 and J3 connections.
5. The customer supplied conduit should be installed in the one hole side of the junction box.
6. The BNC connectors are factory installed on two 100 ft. cables. The BNC connectors from the triax cables should be connected to J2 and J4 connections.
7. Mark the end of one cable with a piece of tape designating either the upstream or the downstream sensor.
8. Terminate the sensor cables per wiring in the 4500 IOM manual.

SERIES 4000 WINDOWED SPOOL INSTALLATION

1. SPOOL
2. ROLL PIN (USED AS A GUIDE FOR #4)
3. O RING
4. SENSOR WINDOW
5. SENSOR HOLDER
6. WASHER (4 PLACES)
7. SCREW (4 PLACES)
8. SILICONE GREASE
9. RUBBER PAD
10. SENSOR & CABLE
11. SPRING
12. CAUTION TAG
13. SENSOR RETAINER

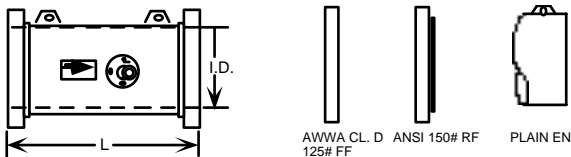


WARNING:
DO NOT REMOVE ASSEMBLY #3 THROUGH #7



INSTALL WITH ARROW POINTING WITH FLOW

SPOOL PIECES MAY BE INSTALLED EITHER IN THE HORIZONTAL PLANE OR IN THE VERTICAL PLANE (WITH FLOW IN THE UP DIRECTION)



L = LAYING LENGTH IN INCHES

SIZE	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48
"L"	12	12	12	14	15	18	21	24	27	30	36	30	36	42	48

SENSOR REMOVAL PROCEDURE

1. Remove conduit from the sensor retainer (12).
2. Unscrew the sensor retainer (12).
3. Gently pull on the sensor cable. The sensor spring (10) and the sensor (9), should "pop" out of the sensor holder (5).
4. Before reinstalling the sensor, carefully clean the sensor grease from the sensor window lens (4).

NOTE: A long 6" cotton swab available at most electronic, or audio, stores works well for cleaning the window.

5. Wipe the end and sides of the sensor clean, removing any grease and grit.
6. Spread a thin 1/32" layer of sensor grease (Dow Corning 111* valve lubricant & sealant) on the end surface of the sensor.
7. Carefully reinsert the sensor into the sensor holder and gently push the sensor all the way in.

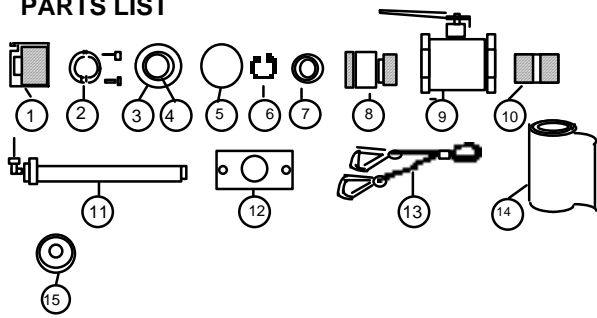
NOTE: If the sensor will not push in, try to loosen the holder screws (7) slightly (without removing the safety wire seal) and shift the holder until the sensor will slide all the way in. Retighten the holder screws.

8. Screw the sensor retainer down firm (hand tight) and reconnect the conduit.

* Type 29 silicon heat sink compound may be used (available at most electronic stores).

SERIES 4000 HS3 SENSOR INSTALLATION

PARTS LIST



ITEM	DESCRIPTION	QTY
1.	RETAINER BRZ	2
2.	SPLIT COLLAR	2
3.	BRASS COLLAR	2
4.	O-RING 1.287 X 2.7	2
5.	O-RING 2.112 X 2.318	2
6.	2" RETAINING RING	2
7.	BEARING SEAL	2
8.	BRASS TAIL PIECE	2
9.	BRZ BALL VALVE	2
10.	1-1/2" NIPPLE	2
11.	SENSOR W/100' CABLE	2
12.	SAFETY PLATE	4
13.	SAFETY CABLE	4
14.	TEMPLATE	1
15.	TEFLON TAPE	1

TEMPLATE INSTALLATION

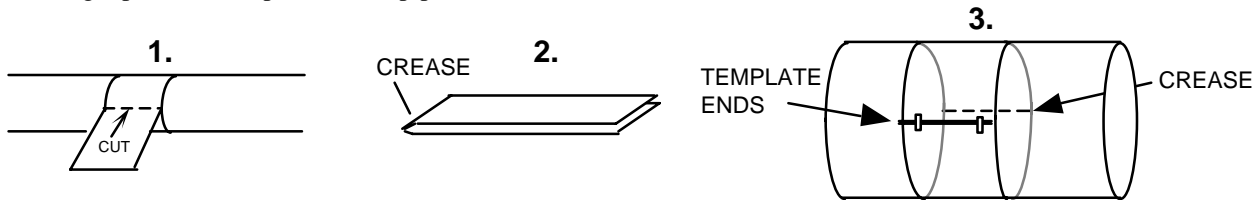
Using tape, attach one end of the template to the pipe and wrap the rest of the template around the pipe.

Pull the template straight and mark the point of overlap on the template. Cut off the excess.

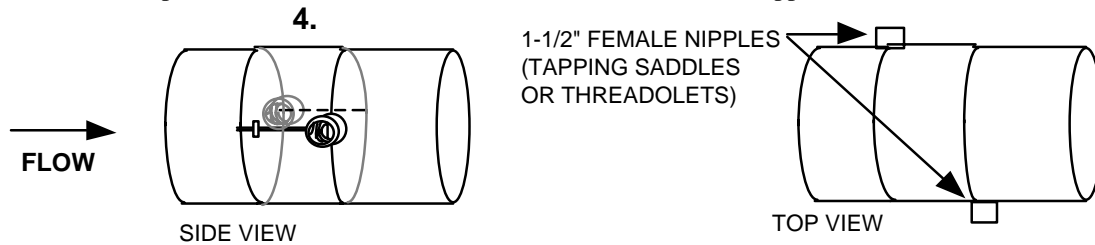
Remove template from pipe. Fold template.

Wrap the template around the pipe so that the crease is on one side of the pipe and the two ends of the template meet on the other side of the pipe.

Try to line up the crease and ends with the horizontal center of the pipe. Tape the ends of the template together with masking tape to hold in place on the pipe.

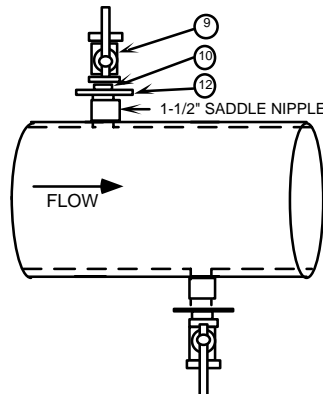


Use a center punch and a hammer. Punch a mark where the template ends meet and the right edge of the template. Repeat step on the other side of the pipe where the crease in the template and the right edge of the template meet (Fig. 4). The center punch marks will become the center line for the 1-1/2" nipples.



TAPPING PROCEDURE

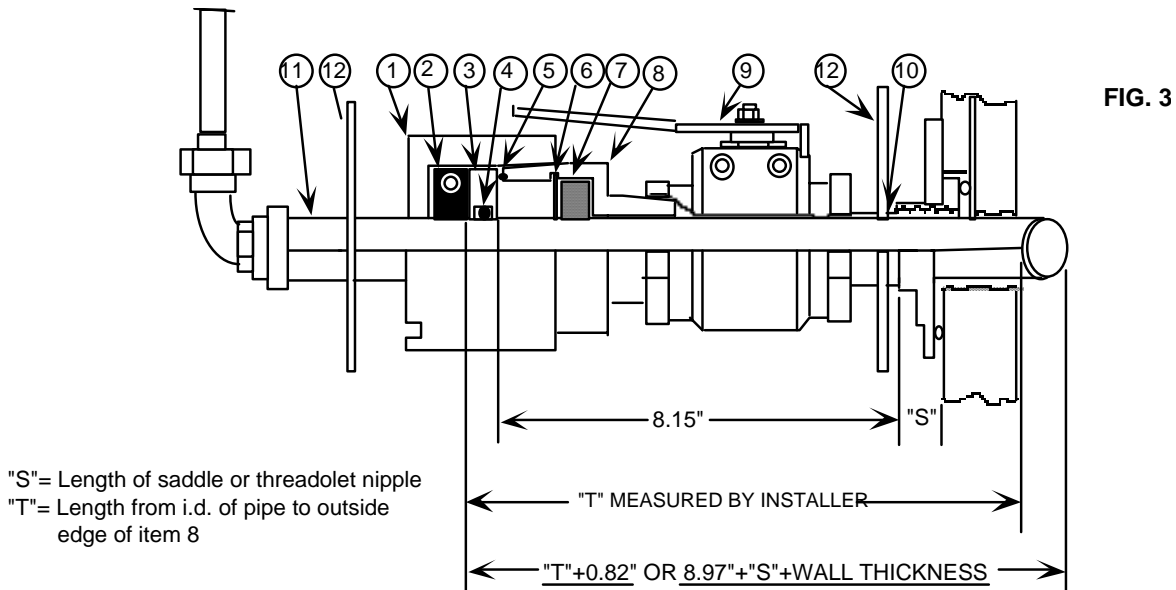
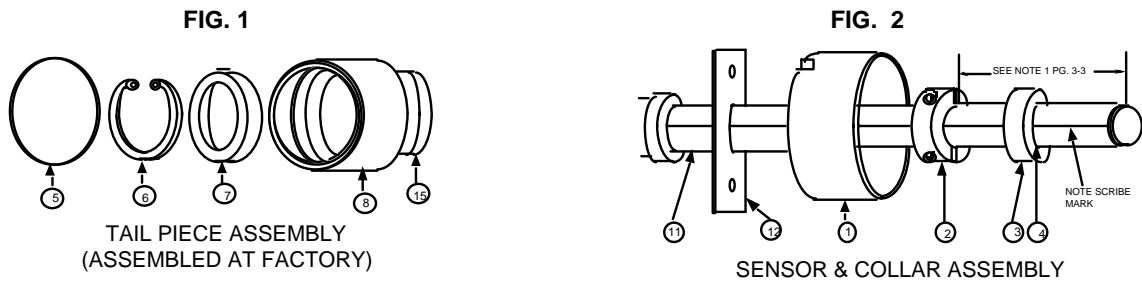
1. Install template and nipples per 3-1.
2. Use Teflon tape, wrap the end of male nipple (10) and screw into female nipple of tapping saddle.
3. Slide safety plate (12) over outer end of nipple.
4. Screw ball valve (9) onto nipple. Adjust valve to the "open" position.



5. Connect tapping machine into end of ball valve, 1-1/2".
6. Use 1.38" minimum tapping bit and tap through pipe wall.
7. Back the tapping bit out past the valve assembly and move the valve handle to the "off" position.

SERIES 4000 HS3 SENSOR INSTALLATION

PREPARATION TO INSTALL SENSORS:



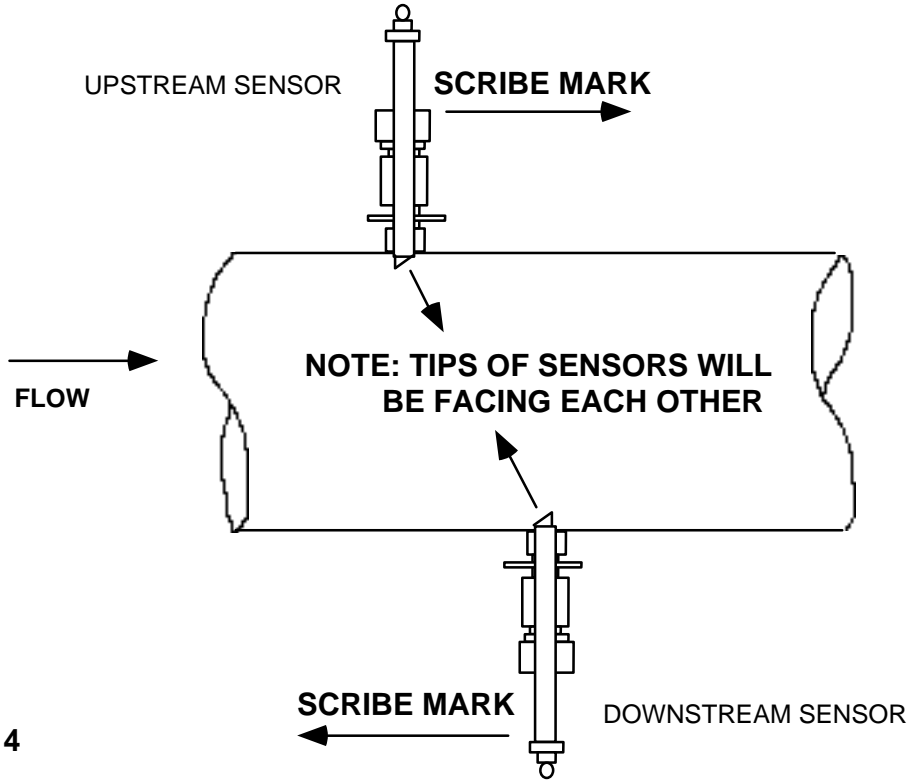
NOTE 1: USE ABOVE FORMULAS TO DETERMINE THE PLACEMENT OF ITEM 2, ONCE COLLAR IS PLACED AT CORRECT DIMENSION TIGHTEN BOTH SOCKET HEAD SCREWS.

1. Screw tail piece assembly (Fig. 1, 5, 6, 7 and 8) into ball valve (9).
2. Slide 12 and 1 onto sensor (11); use Fig. 2.
3. Position collar (2) onto sensor and use above formula to calculate correct dimension. Please note that the collar should already be installed by the factory on new orders, the collar dimension will have to be changed only if pipe dimensions are other than given.
4. Slide brass collar and O-ring assembly (3 & 4) onto end of sensor and butt up against the split collar (2).

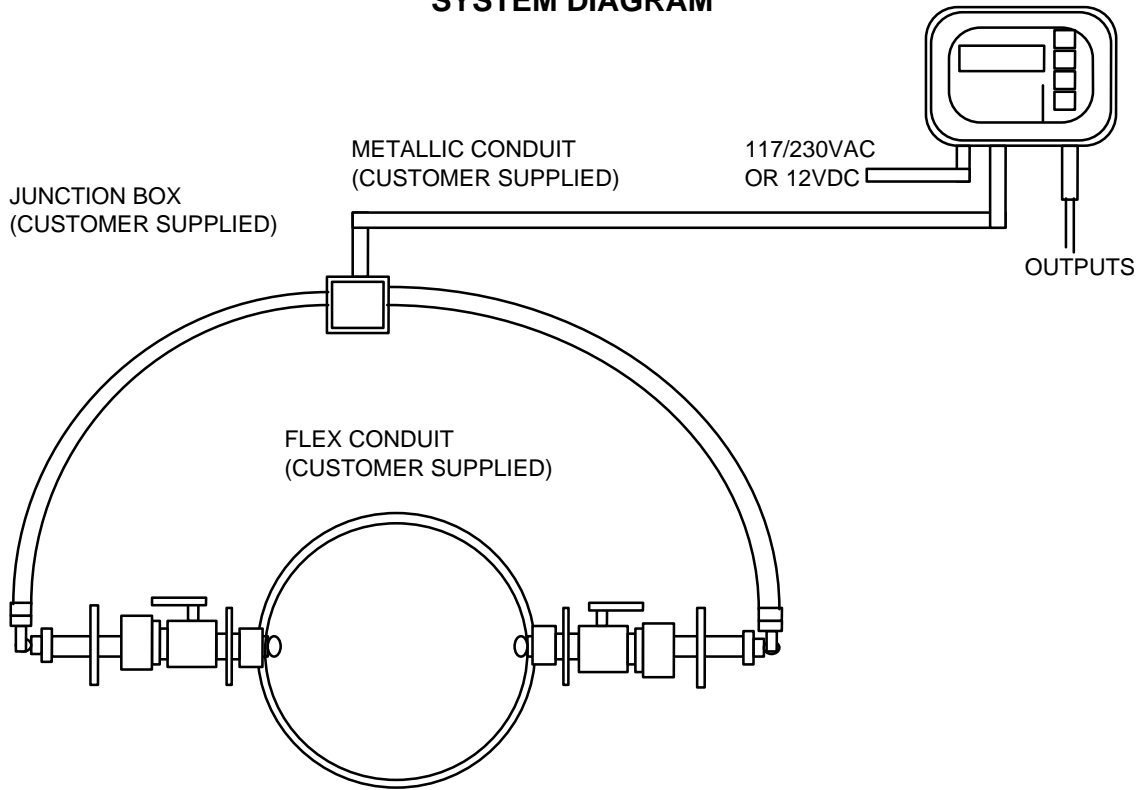
NOTE: USE SOAPY WATER, PETROLEUM JELLY OR SOME TYPE OF LUBRICANT TO SLIDE BRASS COLLAR AND O-RING ONTO SENSOR.

5. Note scribe mark running near the end of the sensor. This scribe mark, when the sensor is installed, should be facing toward the opposite sensor (Fig. 4).
6. Place tip of sensor through bearing seal (7) and carefully push until the sensor stops at the ball valve. Fasten safety cable clip (long length) to opposite safety plate.
7. Turn valve handle to the "on" position and insert the sensor until the brass collar (3) seats on the O-ring on the tail piece (5 & 8).
8. Tighten retainer (1) onto the tail piece (8) using a 1/16" square screw driver shaft in the notch on the end of the retainer.
9. Fasten short length of safety cable to opposite safety plate.

SERIES 4000 HS3 SENSOR INSTALLATION



SYSTEM DIAGRAM



SERIES 4000 INSTREAM REFRACTING SENSOR INSTALLATION

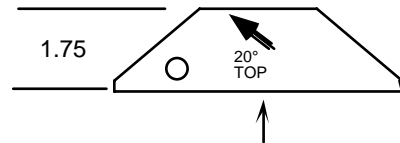
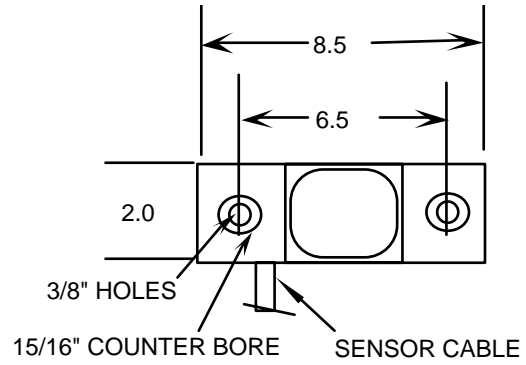
DESCRIPTION

The instream refracting sensors were designed for rectangular or circular concrete channels flowing full at all times. These sensors have a wedge shape to minimize possibilities of catching debris. The sensor is made of PVC materials with 50 ft. of Belden triax cable.

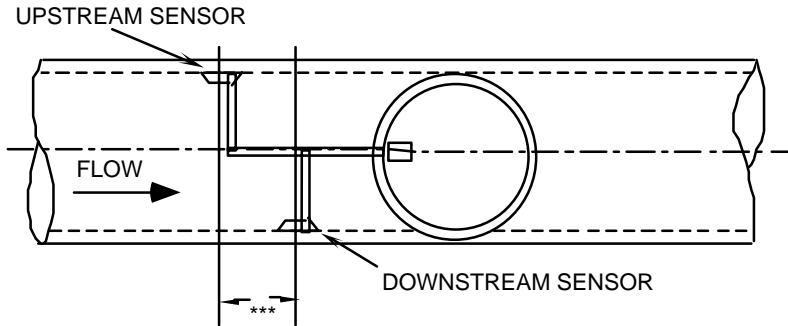
INSTALLATION

Refer to customer Data Sheet in front of this manual. Sensor separation = ____ inches. This dimension is from center line of the upstream sensor to the center line of the downstream sensor. Make sure that the arrow on the downstream sensor is pointing upstream and the arrow on the upstream sensor is pointing downstream. Mark holes on concrete conduit and use lead inserts. Place sensor over lead inserts and attach with screws (customer supplied). Route the sensor cables to the top of the conduit and use customer supplied cable clamps to fasten cable to the pipe at one foot intervals. Route the cables downstream and out the pipe outlet. Secure with cable clamps.

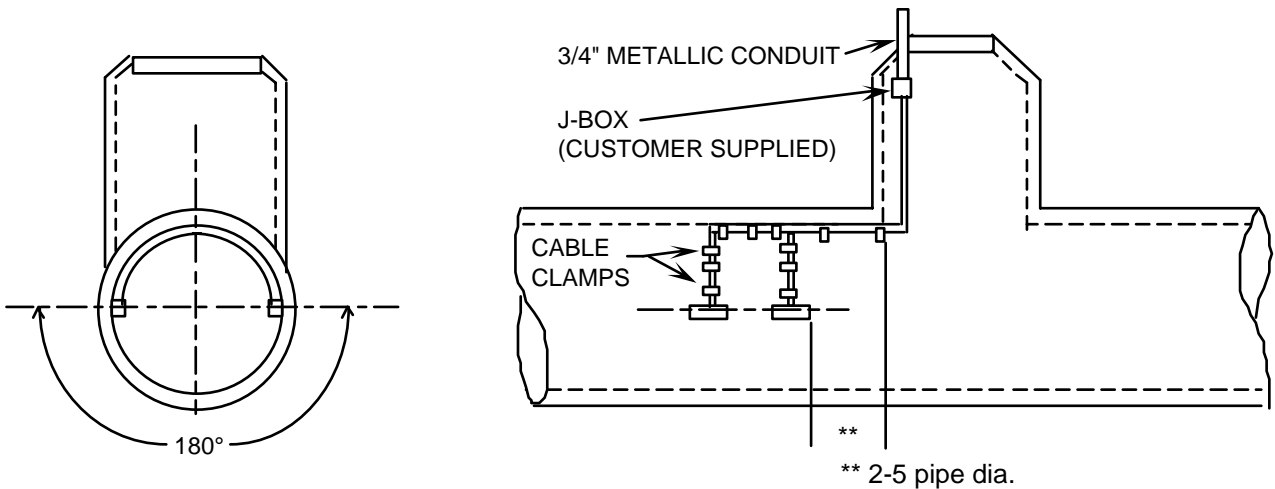
Terminate sensor cables to the 4500 electronics.



NOTE: ARROWS ON TOP OF SENSORS SHOULD BE POINTING TOWARDS EACH OTHER AFTER INSTALLATION



***SENSOR SEPARATION
(THIS DIMENSION IS CRITICAL TO METER ACCURACY)



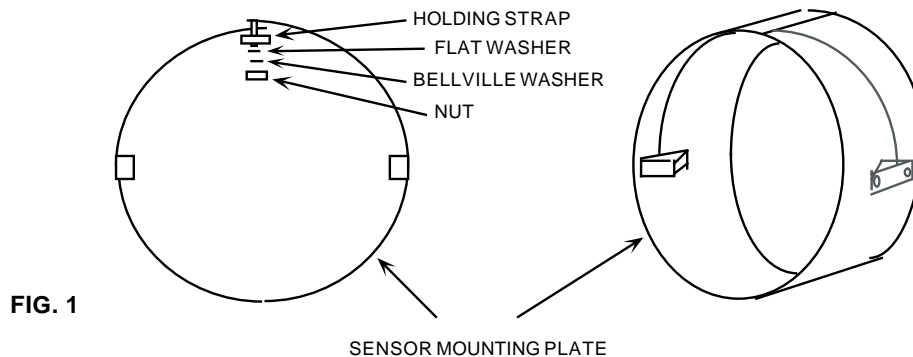
SERIES 4000 WETTED SENSORS WITH HOOP INSTALLATION

DESCRIPTION

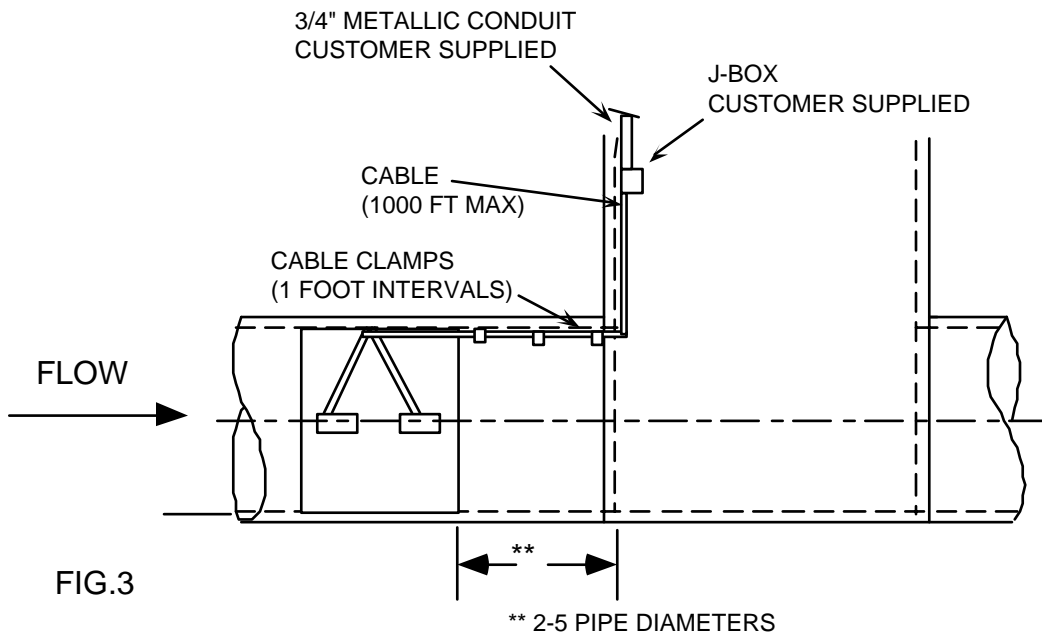
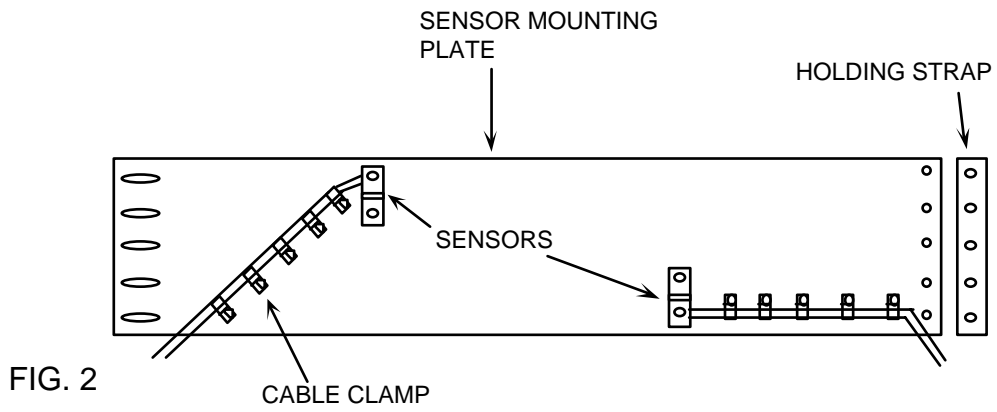
The underwater sensors for the Series 4500 flow meter are premounted on a stainless steel plate at the factory (see Fig. 2). The sensor cables are secured to the plate with clamps. This plate is then formed into a hoop and inserted into the pipe just upstream of the 2-inch conduit opening in the top of the pipe or upstream of the manhole entrance. The sensor cables are then pulled through the conduit and attached to the sensor connections on the Model 4500 electronic enclosure.

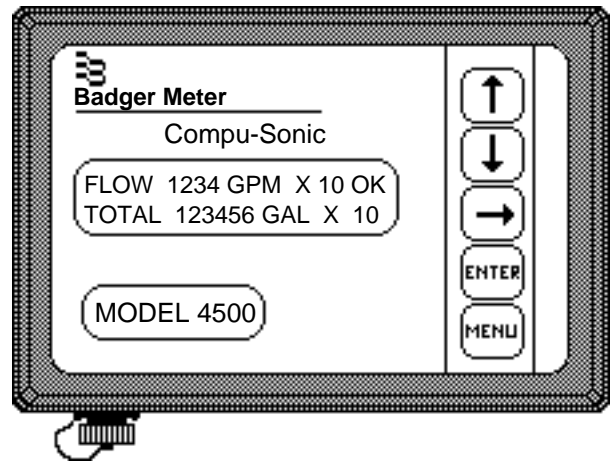
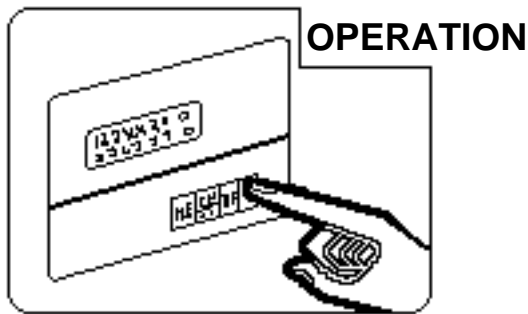
PROCEDURE

1. Inspect the sensor mounting plate for evidence of damage from shipping or handling.
2. Refer to Fig. 1. Form the plate into a hoop. Insert the four 8-32 studs on one end of the plate into the slots on the other end. Loosely attach the holding strap to the four studs with the flat washer, Bellville washer and nut. Compress the hoop to its smallest diameter and tighten the nuts on the holding strap.
3. Lower the sensor mounting assembly into the discharge box at the end of the pipe, positioning it so the sensor cables exit downstream. Insert it into the pipe 3 inches upstream of the 2 inch conduit pipe opening in the top of the pipe or 2 to 5 pipe diameters upstream of the manhole. Position the hoop so the sensors are at 90 and 270 degrees in the pipe.
4. Loosen the nuts to the holding strap. Expand the hoop to the wall of the pipe and loosely tighten the units on the holding strap.
5. Use large "C" ring pliers to secure the mounting plate to the pipe. Starting at the upstream side of the pipe, place the "C" ring pliers between the plate and the holding strap. Slowly spread the mounting plate with the pliers forcing the mounting plate against the pipe. Using a rubber head mallet, tap the plate starting at the bottom and up the sides. Tighten the nut of the holding strap on the end you have been spreading. Place the "C" ring pliers on the downstream side of the plate and repeat the same process. Go back to the upstream end and loosen the end nut and use the "C" ring pliers to continue to force the plate against the pipe wall. Repeat this process until the mounting plate is secured against the pipe wall and there are no gaps between the plate and wall.
6. Refer to Fig. 3. Route the sensor cables downstream to exit.
7. This completes the sensor installation. See the electronic assembly installation section for connecting and securing the cables.



SERIES 4000 WETTED SENSORS WITH HOOP INSTALLATION





GENERAL DESCRIPTION

The Series 4500 is an ultrasonic transit-time flow meter designed to measure fluid flows in full pipes. The meter is equipped with a 2-line, 24 character per line LCD display, 4-20 mA DC signal output, 4 programmable relays and an RS232 serial communications port.

The Series 4500 is microprocessor based and provides a number of menu functions from the front panel which allows the user to modify or interrogate meter operations to suit the user's needs. These keys are the UP arrow, DOWN arrow, RIGHT arrow, MENU and ENTER.

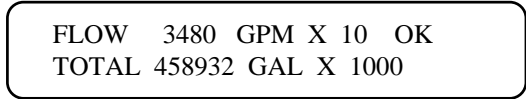
The MENU key allows access to the Status Mode or Calibration Mode of the meter. It also can be used to return to normal operation any time you are in the Status or Calibration Mode. If you press the MENU key while in the Calibration Mode, the processor will store any changes made up to that point, but will retain the previous programming after that point and return to the normal operating screen.

The ENTER key is used to store any data changes that are made in the Calibration Mode and step through the screens of the Status or Calibration Modes. The ENTER key must be pressed to store the change made. Pressing the MENU key before the ENTER key will not store the change.

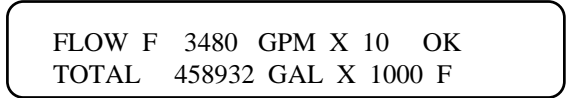
The UP, DOWN, and RIGHT arrow keys are used for selecting or making changes in the various screens of the meter in the Status or Calibration Mode.

To prevent unauthorized entry into the Calibration Mode of the meter, there is a Security screen that requires the correct security code to be entered in order to gain access. The security code when shipped from the factory is 0000.

When power is first applied, the display will show squares across the top line for a second and then the display will show the normal operating screen, typically flow and total. The flow rate value will have 3 X's for 3 to 5 seconds while the meter is going through its set up procedure. The meter will then begin to indicate the flow rate if an OK is displayed in the right corner of the top line as shown below.



If your meter has been programmed at the factory for bi-directional flow, there will be a letter that follows the FLOW word and a letter at the right end of the second line that will indicate the direction of the flow. The letter will be F for forward flow and R for reverse flow. The screen below shows this feature.



There are two totalizer registers in the meter. One for forward flow and the other for reverse flow. While in the normal operating screen, the UP or DOWN arrow keys can be used to view the totalizer that is not displayed.

The following pages in this section cover the Status and Calibration Modes' menus. They will be listed in the order of the sequence of screens.

The MENU key can be used to exit from any function in the Status or Calibration Modes and go directly back to the normal operating screen. The DOWN arrow key can be used to step backwards in the main function screens.

STATUS MODE

The Status Mode allows the user to determine the operational status of the Series 4500 as well as perform a self diagnostic and a flow simulation. Normal meter operation will still be performed while in the Status Mode except when in the flow simulation function.

To enter into the Status Mode, press the MENU key and the following screen will appear:

PRESS UP FOR CALIBRATION
PRESS DOWN FOR STATUS

This screen allows entry into the Calibration Mode or the Status Mode. Press the DOWN arrow key and the following screen will appear:

Measurement Data
Press UP to Activate

This screen allows entry into the measurement data of the meter. This is normally used in troubleshooting to detect signal strength and error codes.

Press the UP arrow key and the following screen will appear:

ZOF = 0000 NOR = BE38
DEL = A9C2 T12 = 02C4

This screen of the measurement data gives the values of the captured zero offset (ZOF), the normalized flow rate (NOR), the phase shift (DEL) and the signal crossing time (T12). These will be discussed in more detail in the Troubleshooting Section of this manual.

Press the ENTER key and the following screen will appear:

ERR 0000 AGC = 25024F
SIG:

This screen shows the error codes and the AGC (automatic gain control) value on the first line and the signal strength indication on the second line.

The various error codes are listed in the Troubleshooting Section of this manual. The first two hexadecimal digits of the AGC value indicate the relative strength of the received signal with a value of 9F for a minimum signal and 10 the maximum signal.

You may switch between the two screens by pressing the UP arrow key.

Press the ENTER key and the following screen will appear:

SELF TEST
PRESS UP TO ACTIVATE

This screen allows entry into the self test diagnostics routine. Press the UP arrow key and the following screen will appear:

SELF TEST
TRANSMIT: <<PASSED>>

The self diagnostic first tests the transmitter section of the electronics. A brief message will be displayed indicating that testing is in process and then a PASSED or FAILED message will appear. The self test automatically steps through each test segment.

The following screen will appear next:

SELF TEST
RECEIVER: <<PASSED>>

Again a brief message will be displayed indicating that testing is in process and then a PASSED or FAILED message will appear. This test checks that the receiver section of the electronics is functioning properly. The self test then checks for the presence of a signal. If a received signal is present and within the timing limits, the self test will step to the EEPROM test. If there is no signal, this will be indicated on the display. If there is a signal arriving at a time shorter than expected, then 'T12 Short' will be displayed. If there is a signal arriving at a time longer than expected, then 'T12 Long' will be displayed.

The following screen will appear next:

SELF TEST
EEPROM: <<PASSED>>

This screen indicates that the EEPROM of the microprocessor is being tested. After a few seconds the "TESTING" message will change to either "PASSED" or "FAILED". The following screen will appear:

SELF TEST
*****Completed*****

This screen indicates that the self test function of the Status Mode is completed. The following screen will appear:

Flow Simulation
Press UP to Activate

This screen allows the entry into the flow simulation function. This function can be used to simulate the flow from zero to full scale. It will drive the 4-20 mA DC output and the relays if assigned to either of the flow set points.

When in this function the normal flow measurement of the meter is discontinued. No totalization of flow will take place, but any totalization in Flow Simulation will record on the normal totalizer.

Press the UP arrow key and the following screen will appear:

FLOW 0000 GPM X 10 SM
Badger Meter, Inc.

This screen is the flow simulation screen. In the top, right corner of the display are the letters SM. These letters are to prevent confusion with the normal flow screen. **The meter will stay in this mode until the MENU key is pressed.**

To adjust the flow simulation to a specific flow rate, use the RIGHT arrow key to move the cursor under the

digit to be adjusted and use the UP or DOWN arrow keys to adjust the digit to the desired value. For example, if you wanted to simulate a flow rate of 2500 GPM, move the cursor under the second digit from the left with the RIGHT arrow key and press the UP arrow key twice for a value of two (2). Then move the cursor under the third digit from the left with the RIGHT arrow key and press the UP arrow key five times for a value of five (5). The display will now show 0250 which is 2500 GPM with the X10 multiplier.

To exit from the flow simulation press the MENU key. The screen will return to the normal operating screen.

To exit from any screen and go back directly to the normal operating screen, press the MENU key.

This completes the Status Mode operation instructions.

CALIBRATION MODE

The Calibration Mode allows the user to calibrate and adjust various functions related to the operation of the Series 4500. A brief description of each follows.

4-20 mA Calibration - Adjusts the zero and span (4-20 mA) output.

Meter Rescale - Changes the full scale range of the meter.

Meter Factor - Adjusts meter factor for field calibration.

Zero Offset - Performs zero offset capture at no flow condition.

Totalizer - Enables or disables totalizer or clears totalizer.

Response Time - Adjusts the response time of the meter.

Failure Mode - Selects default output of meter when loss of signal occurs.

Integrator Configuration - Sets contact output in multiplies of the totalizer multiplier.

Remote Tot Configuration - Sets closure time of relay for remote totalizer.

Set Point Configuration - Adjusts two set points for high or low flow alarms.

Relay Configuration - Assigns alarms or set points to the four relays.

Security ID - Changes the security code.

To enter into the Calibration Mode, press the MENU key while the display is in the normal operating screen. The following screen will appear:

PRESS UP FOR CALIBRATION
PRESS DOWN FOR STATUS

Press the UP arrow key and the following screen will appear:

SECURITY ID
Input 4 Digit Id - - - -

This screen is the Security screen which requires the correct 4 digit number to allow entry into the Calibration Mode of the Model 4500. To change the value of each digit, move the line under the digit to be changed with the RIGHT arrow key and then use the UP or DOWN arrow keys to change the value of the digit. When the 4 digit number is correct, press the ENTER key. If the number is incorrect the meter will go back to the normal operating screen. If the number is correct the following screen will appear:

4-20 mA Calibration
Press UP to Activate

This screen allows entry into the Calibration screens for the 4-20 mA current output. Press the UP arrow key and the following screen will appear:

4-20 mA Calibration
ZERO WORD = 2300

This screen allows adjustment of the zero output to 4 mA. The 4-20 mA output can be monitored on the test jacks on the bottom of the back half of the housing, red jack positive, black jack negative. **The 4-20 mA output must be connected to a load for the test points to work.** Use the RIGHT arrow key to position the cursor under the digit to be adjusted. Fine adjustment is made on the far right digit with the adjustment becoming more coarse with each digit to the left. Use the UP or DOWN arrow keys to adjust for the correct output. The display Zero Word is for reference only. Press the ENTER key to store the value. The following screen will appear:

4-20 mA Calibration
SPAN WORD = AD00

This screen allows adjustment of span to 20 mA. The 4-20 mA output can be monitored on the test jacks on the bottom of the back half of the housing. Use the RIGHT arrow key to position the cursor under the digit to be adjusted. Fine adjustment is made on the far right digit with the adjustment becoming more coarse with each digit to the left. Use the UP or DOWN arrow keys to adjust for the correct output. The display Span Word is for reference only. Press the ENTER key to store the value. The following screen will then appear:

Meter Rescale
Press UP to Activate

This screen allows entry into the meter rescale screen which increases or decreases the full scale of the meter. Press the UP arrow key and the following screen will appear:

Meter Rescale
Full Scale 0900 x 10

The full scale value shown on this screen is the present full scale (20 mA output). To change the full scale of the meter, use the RIGHT arrow key to move the cursor under the digit to be adjusted and use the UP or DOWN arrow keys to adjust the digit to the desired value. For example, if you wanted to change the full scale from 9000 to 10000, move the cursor under the first digit from the left with the RIGHT arrow key and press the UP arrow key once for a value of one (1). Then move the cursor under the second digit from the left with the RIGHT arrow key and press the DOWN arrow key nine times for a value of zero (0). The display will now show 1000 which is 10000 with the X10 multiplier.

There is a maximum and minimum full scale limit. When the full scale value reaches either limit, the digits will stop changing.

Remember: Changing the full scale of the meter will cause the 4-20 mADC output to change to reflect the new full scale value.

Press the ENTER key to store the value. The following screen will appear:

Meter Factor
Press UP to Activate

This screen allows the user to calibrate the Model 4500 to reproduce actual flow conditions. The user can modify the meter factor for calibration of the meter to a known standard.

Press the UP arrow key and the following screen will appear:

Meter Factor
Meter Factor = 1.000

The user can modify the meter factor from a value of 0.800 to 1.200. The meter factor is the relation between the indicated flow rate of the meter and the actual flow rate as proven by calibration tanks or other means. If, for example, the meter was installed on a pipe and due to uncertainty in the pipe dimensions, the meter was determined to be indicating a flow rate of 5.6% higher than the actual flow, the flow meter is indicating 1.056 times the true value. The initial meter factor will be 1.000 as set as the factory.

To correct for the 5.6% high error, the meter factor must be changed to 0.947 (1/1.056). To change the meter factor, press the RIGHT arrow key to move the cursor under the first digit to the right of the decimal point and press the DOWN arrow key to change the value to 9. Press the RIGHT arrow key to move the cursor under the second digit to the right of the decimal point and press the UP arrow key to change the value to 4. Press the RIGHT arrow key to move the cursor under the third digit to the right of the decimal point and press the UP arrow key to change the value to 7. Pressing the MENU or ENTER key will store the new value.

After pressing the ENTER key the following screen will appear:

Zero Offset
Press UP to Activate

This screen allows the user to capture and correct for zero offsets that may be present in the metering system. It

is intended to be used for periodic maintenance to correct for small zero drifts. **THE FLOW IN THE PIPE MUST BE ZERO TO USE THIS FUNCTION. IF FLOW EXISTS IN THE PIPE, USE OF THIS FUNCTION WILL CREATE LARGE ERRORS IN THE METER.** Therefore, the user must prepare for use of this function. Appropriate valving must be done to ensure that no flow exists; allow at least 10 minutes for the fluid motion to settle out. To start the Zero Offset function press the UP arrow key and the following screen will appear:

Zero Offset
STAT : Evaluating >

The zero offset function is now activated and the display will indicate that it is evaluating for any offsets in the system. After a period of approximately 20 seconds, the screen will display: 'ERROR: Failed' or 'CAPTURED: Press UP to Sav'.

If an error is indicated, it means that an offset was measured greater than is expected under normal conditions. The pipe needs to be rechecked to verify that there is no flow. Press the ENTER key to step out of the error screen. The display will step to the Totalizer Function screen. If you desire to try the zero offset function again, press the DOWN arrow key and the display will step back to the zero offset screen. Repeat the above procedure.

If the screen indicates that an offset is captured, press the UP arrow key to store this value. After the UP arrow is pressed the following screen will appear:

Totalizer
Press UP to Activate

This screen allows the totalizer to be enabled, disabled, or reset to zero. Press the UP arrow key and the following screen will appear:

Totalizer
ENABLED

This screen allows the totalizer to be enabled or disabled. If the totalizer is enabled, the totalizer will be displayed on the second line of the normal operating screen with its appropriate multiplier and units of measurement. If the totalizer is disabled then the second line of the normal operating screen will have Badger Meter, Inc. displayed. Use the UP or DOWN arrow keys to make your selection and press the ENTER key.

If you selected DISABLED, the next screen displayed will be the Response Time function. If you selected ENABLED the following screen will appear:

TOTALIZER CLEAR
Press UP to Activate

This screen allows the user to clear the value in the totalizer registers of both forward and reverse totalizers if applicable. Press the UP arrow and the following screen will appear:

TOTALIZER CLEAR
Press UP to Reset

This screen actually resets the totalizer(s) to zero. Press the UP arrow to clear the totalizer(s) or ENTER to not clear the totalizer(s). The following screen will appear:

Response Time
Press UP to Activate

This screen allows setting of the response time of the meter to changes in the flow rate. Press the UP arrow key and the following screen will appear:

Response Time
Response Const: 007

This screen sets the response time of the meter. The selections are from 1 to 7. The response time for each of the selections is: 1 = 2 seconds; 2 = 4 seconds; 3 = 8 seconds; 4 = 16 seconds; 5 = 32 seconds; 6 = 64 seconds; 7 = 128 seconds. Use the UP or DOWN arrow keys to change to the desired response time. Press the ENTER key to save. The following screen will appear:

Failure Mode
Press UP to Activate

This screen allows setting of the default output of the meter in the event there is a loss of signal failure. There are three available selections. Zero, Full Scale or Hold Last Reading. The selection of zero will drive the meter output to 4 mA. The selection of full scale will drive the meter to 20 mA. The selection of hold last will retain the last flow value before loss of signal.

Press the UP arrow key and the following screen will appear:

Failure Mode
FAIL TO: ZERO

This screen allows selection of the failure mode to zero, full scale, or hold last reading. Use the UP or DOWN arrow key to make the desired selection. Press the ENTER key to store the selection. The following screen will appear:

Integrator Configuration
Press UP to Activate

This screen allows entry into the contact integrator function. This feature can be used for activating a sampler or pacing a chemical feed device if assigned to one of the relay outputs. The rate of contact is in multiples of the totalizer multiplier. The pulse width or contact time can also be set for the required time for the external device.

Press the UP arrow key and the following screen will appear:

Contact Integrator
0001 x 1000 GAL

This screen allows setting of the contact output based on specific volume of measured flow. This can be selected on multiples of the totalizer multiplier. The above screen shows a totalizer multiplier of 1000 gallons. To have a contact every 10,000 gallons, move the cursor with the RIGHT arrow key under the third digit from the left and use the UP arrow key to change it to 1. Move the cursor with the RIGHT arrow key under the last digit and use the DOWN arrow key to change it to 0.

Press the ENTER key to store the new setting and the following screen will appear:

Integrator Pulse Width
ON FOR 0002 X 0.010 SEC

This screen allows setting of the pulse width or contact closure time for the contact integrator output. For example, if the external contact output device is going to require a closure time of 50 milliseconds, then the on time must be changed to 0005. That is, $0.050/0.010 = 5$. To change the on time, use the RIGHT arrow key to move the cursor under the last digit and the UP arrow key to change it to 5.

Press the ENTER key to store the new setting and the following screen will appear:

Remote Configuration
Press UP to Activate

This screen allows the entry into the remote totalizer configuration setup. If a relay has been assigned to the remote totalizer, then the relay will close every increment of the display totalizer. The configuration screen sets the closure time of the relay. Press the UP arrow key and the following screen will appear:

Remote Tot Pulse Width
ON FOR 0005 X 0.010 SEC

This screen allows the setting of the pulse width or contact closure time for the remote totalizer output. For example, if the external totalizer device requires a closure time of at least 80 milliseconds, then the on time must be changed to 0008. That is, $0.080 / 0.010 = 8$. To change the on time, use the RIGHT arrow key to move the cursor under the last digit and the UP arrow key to change it to 8.

Press the ENTER key to store the new setting and the following screen will appear:

Set Point Configuration
Press UP to Activate

This screen allows entry into the configuration screens for the two set points. The set points can be set up for either high or low alarms with desired dead band. Press the UP arrow key and the following screen will appear:

SETPOINT = 01
ON AT 00.0% OFF AT 00.0%

This screen allows the adjustment of the number 1 set point as a high or low alarm as well as the dead band. **For a low alarm, the ON value must be a lower value than the OFF value. For a high alarm, the ON value must be a higher value than the OFF value.** For example, to make the set point a high alarm at 90% of full scale flow with a 10% dead band, press the UP arrow key to change the ON value to 90.0. The RIGHT arrow key is used to move the cursor under the digit to be changed. Press the ENTER key to move the cursor under the OFF digits. Press the UP arrow key to change the OFF value to 80.0. Press the ENTER key to store these settings. The following screen will appear:

SETPOINT = 02
ON AT 00.0% OFF AT 00.0%

This screen is for setting the number 2 set point. Use the same procedure as described for the number 1 set point. After pressing the ENTER key to store the settings, the following screen will appear:

RELAY CONFIGURATION
Press UP to Activate

This screen allows entry into the relay configuration screens where the four relays are assigned to desired functions. Press the UP arrow key and the following screen will appear:

RELAY ASSIGNMENT
RELAY 01 => NONE

This screen allows the selection of the desired assignment to the number 1 relay. The following functions are available:

NONE - Relay not used
DIR - Direction output for forward and reverse flow
TX - Transmitter failure in the electronics
LOS - Loss of signal
EEPRM - EEPROM failure
TOTL - Remote totalizer output
CINT - Contact integrator output
PNT#1 - Set point #1
PNT#2 - Set point #2

Use the UP or DOWN arrow keys to make the desired selection. Press the ENTER key to store the selection. The next screens will be for relays 2, 3 and 4. The same procedure is used as for the number 1 relay. After the selection is made for the number 4 relay, the following screen will appear:

SECURITY ID
Press UP to Activate

This screen allows entry into the Security Identification where the security code may be changed. Press the UP arrow key and the following screen will appear:

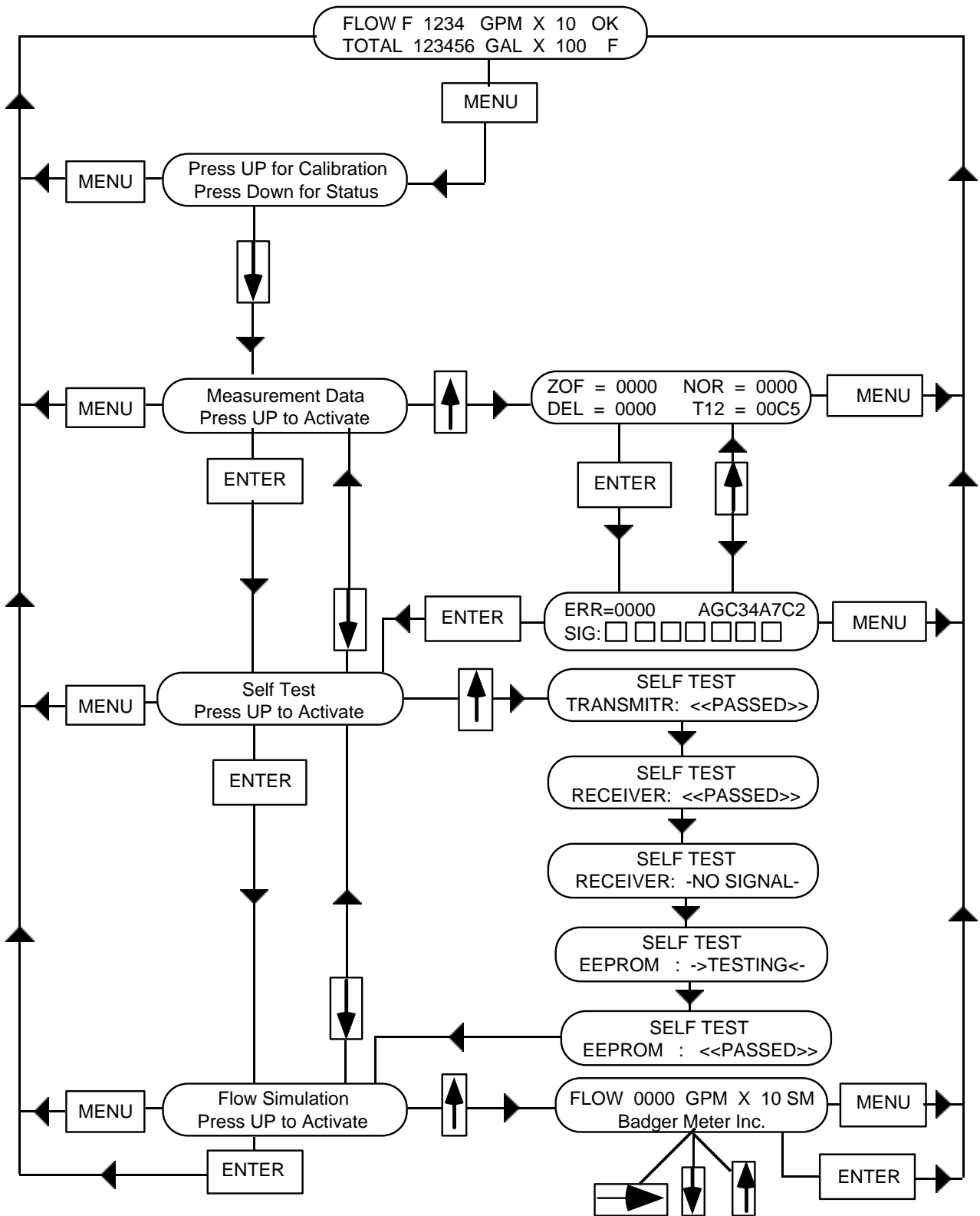
SECURITY ID
Input 4 Digit Id 0000

This screen will show the present security code in the meter. To change the security code move the cursor with the RIGHT arrow key under the digit to be changed. Use the UP or DOWN arrow keys to change the value. The value can be 1 through 9 and A through F. After the new code has been entered, press the ENTER key to store the new values. The display will then return to the normal operating screen.

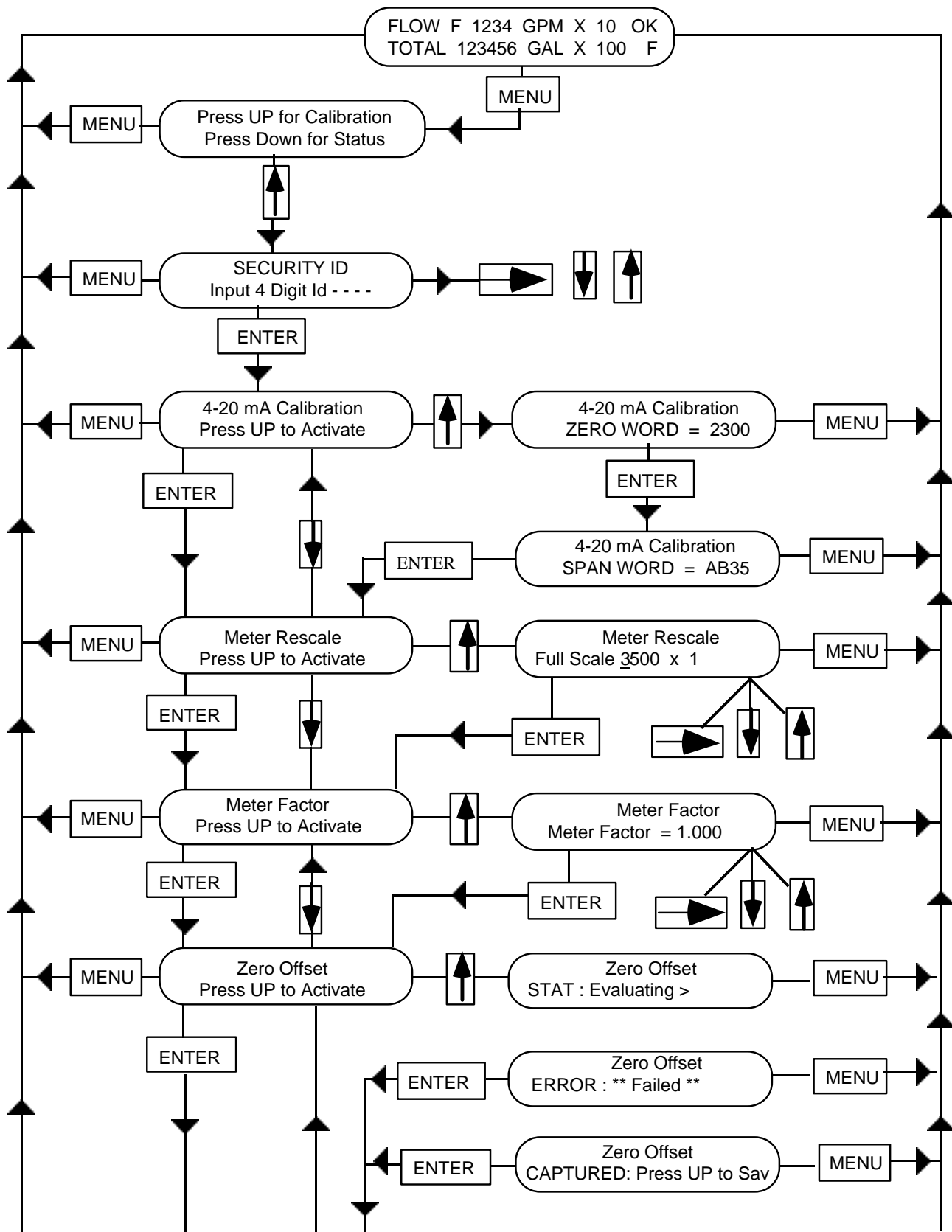
NOTE: At any time after a change has been entered in the Calibration Mode, the MENU key can be pressed and the display will return to the normal operating screen. Also the DOWN arrow key can be used to step backwards through the main function screens of the Calibration Mode.

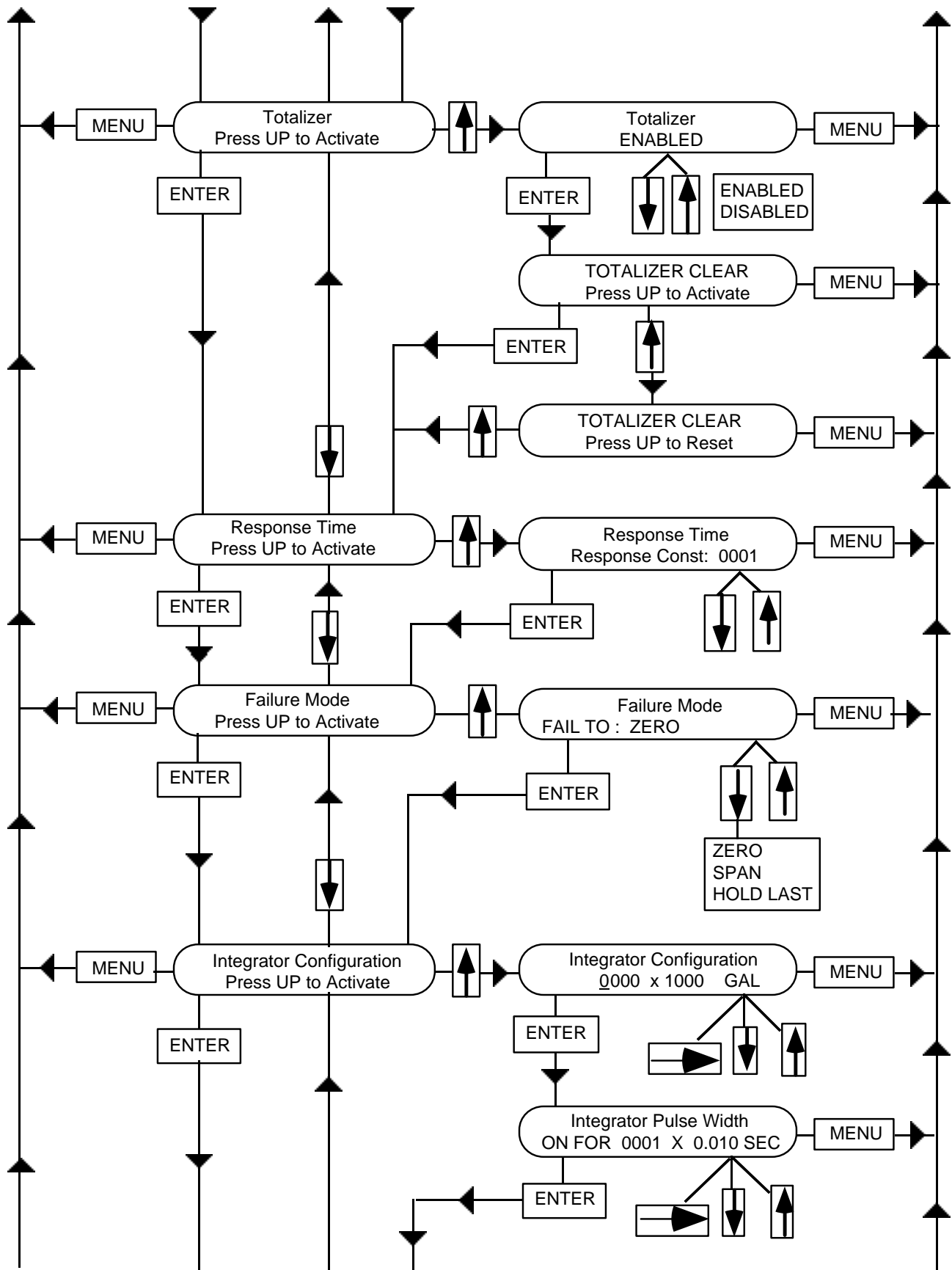
The following pages diagram the menu screens for the Status and Calibration Modes.

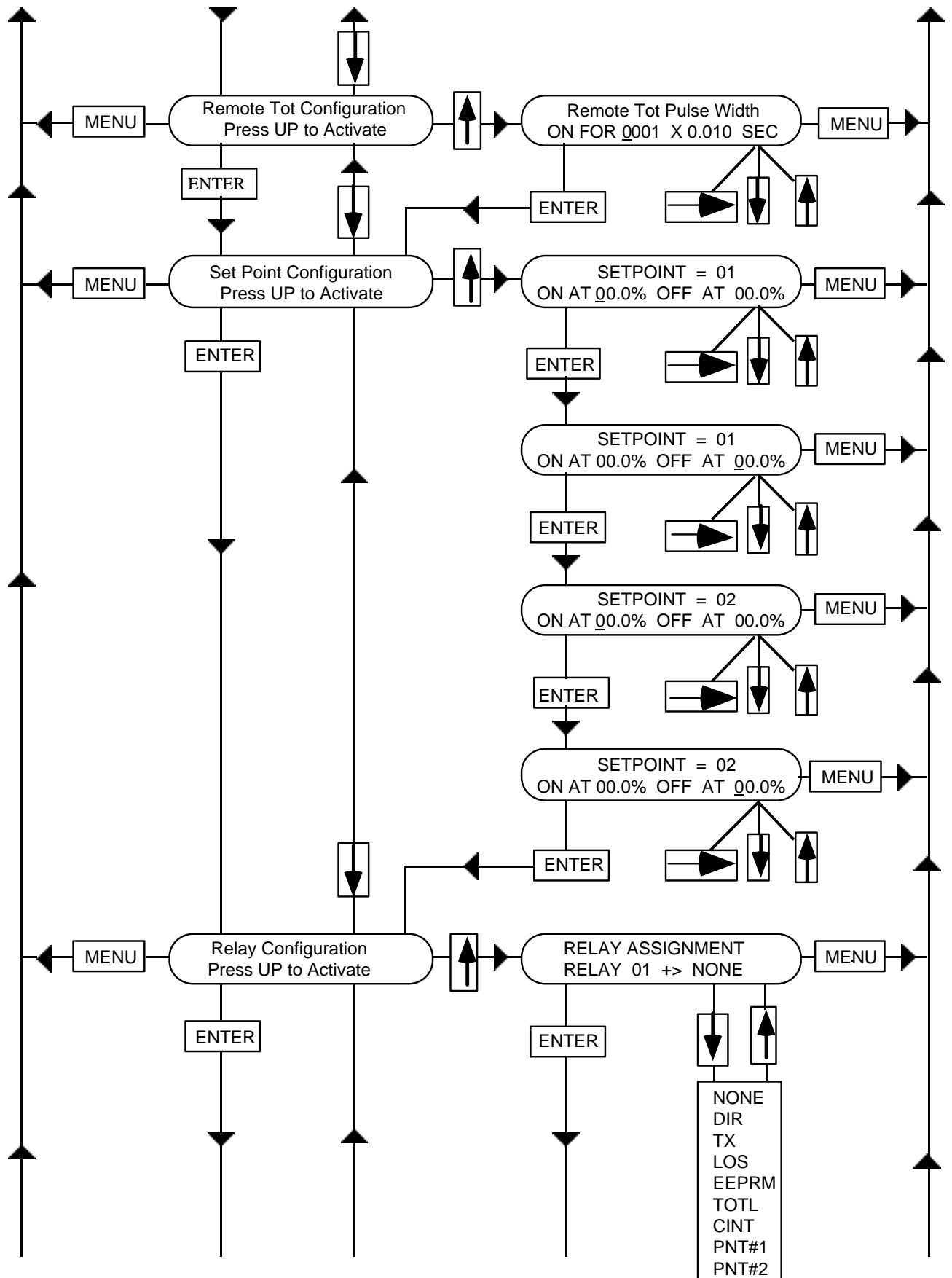
4500 STATUS MODE

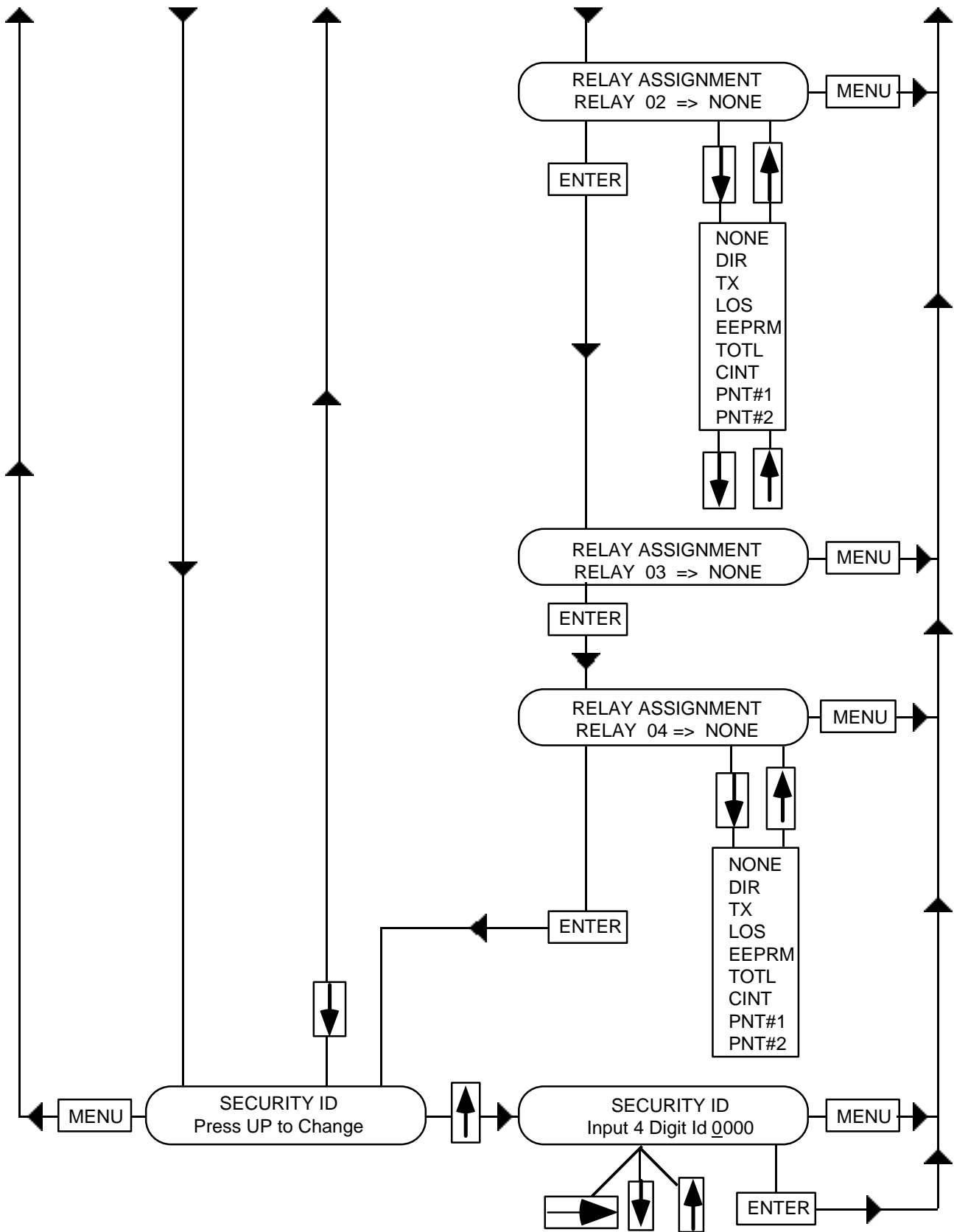


4500 CALIBRATION MODE











GENERAL

The Series 4500 is equipped with self test features which allow the user to identify the operation status of the unit and with the help of this section of the IOM manual to determine proper action to be taken. This section details the meaning of the operational codes which appear in the main menu, the meaning of the self test features, and provides a step by step troubleshooting chart for determining the fault and the necessary action.

Operational Codes. The main menu of the Model 4500 indicates flow rate and flow total. In the upper right hand side of the display appears an operational code which indicates the operating condition of the meter. When the meter is first powered up, the flow rate will display XXXX and there will not be an operational code. The microprocessor is initializing the meter constants and performing a self test to ensure that all areas of the electronics are operating properly. This may take several seconds.

After initialization, the X's in the flow rate will change to 0's. The operational code will display an OK which indicates the meter is operating properly. The meter may recycle a few times before locking onto a good signal. Should an OK not be displayed, refer to the troubleshooting chart for appropriate action.

The following is a list of the operational codes and their meanings.

- OK - Nominal Operation
- NS - No Signal Detected
- XM - Transmit Confirm Failure
- TL - Signal Transit Time Out of Bounds (too long)
- TS - Signal Transit Time Out of Bounds (too short)
- TM - FIFO Error (missing or misaligned timing mark)
- OF - Amplitude Overflow
- UF - Amplitude Underflow
- GE - Gain Error
- CM - Communications Mode Enabled

Measurement Data Screen in Status Mode: The Measurement Data screen of the Status Mode displays several

measurement parameters that can be used to determine the operational status of the flow meter. These screens are intended to help facilitate troubleshooting should a problem exist, especially when communicating with the factory Service Department. The following is an explanation of the data:

- ZOF - Value of the capture zero offset.
- NOR - Hexadecimal flow rate in percent of full scale.
- DEL - Hexadecimal measured phase in percent of full scale.
- T12 - Hexadecimal measured average transit-time of the signals in microseconds.
- ERR - Error codes.
- AGC - First two hexadecimal digits represent relative signal strength with 9F being minimum signal strength and 10 being maximum signal strength.

REPLACEMENT OF PARTS

While the Series 4500 has been designed and built for maximum reliability, there can be instances where replacement of parts may be necessary. In those cases where the troubleshooting procedure calls for replacement of a part, the factory should be contacted for authorization to send in a defective part for repair or replacement.

The Series 4500 has been designed so that the front housing contains the major electronic hardware and can be easily removed and installed. It also allows the replacement unit to be preprogrammed with no adjustments required when installing the new unit. For this reason, we must know the serial number of the defective unit when the user contacts the factory for replacement or repair. Refer to the Installation Section of this manual for disassembly instructions.

The back housing contains the power supply circuit board. This replacement will require a little more effort. Refer to Figure 5-1. Disconnect the power wires, sensor cables, 4-20 mA DC wires and conduit connections. Remove the two "O" Ring back housing mounting screws.

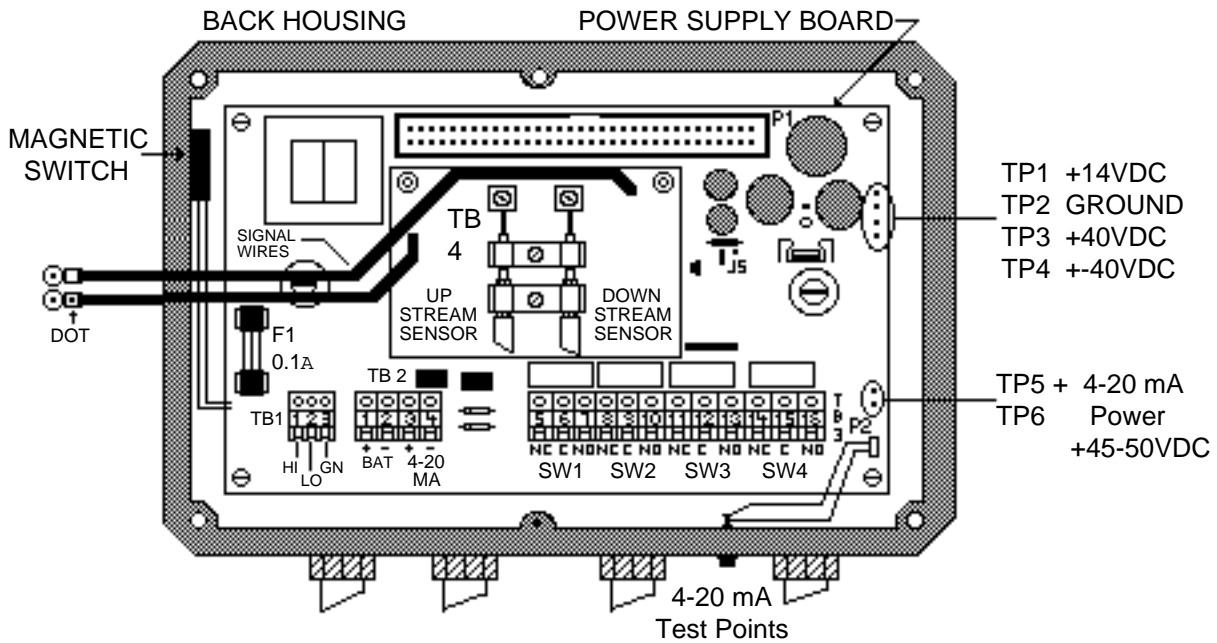


FIGURE 5-1

TROUBLESHOOTING CHART

On the following two pages is the troubleshooting chart for the Series 4500 flow meter. This chart will help you in isolating possible causes for problems you may encounter and give suggested corrective actions.

In the troubleshooting chart, there will be areas that require certain tests to be performed. The following describes these tests.

Sensor cable connection continuity test. This test will require the use of an ohmmeter. Connect the test leads of the ohmmeter to Points 1 and 3 of the sensor cable connections on the power supply as shown in Figure 5-2. If the signal wires on the power supply board are still connected to the front housing electronics, the ohmmeter

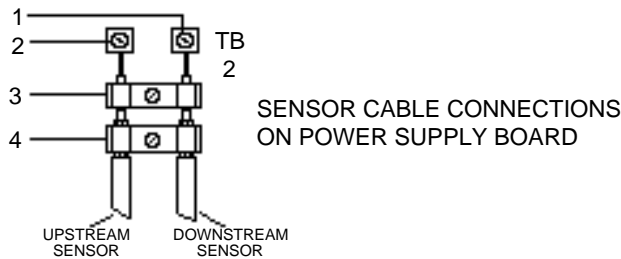


FIGURE 5-2

should read 5000 ohms +/- 5%. If the signal wires are not connected, the reading should be 10,000 ohms +/- 5%. Repeat this test at Points 2 and 3.

Connect the test leads to Points 3 and 4. The reading should indicate infinity (or an open).

Connect the test leads to Points 1 and 4, then 2 and 4. The reading should indicate infinity (or an open).

Power supply voltage test. This test will require the use of a voltmeter. **NOTE:** With the front housing removed, a magnet will be required to close the magnetic switch on the back housing in order to perform this test. Refer to Figure 4-1.

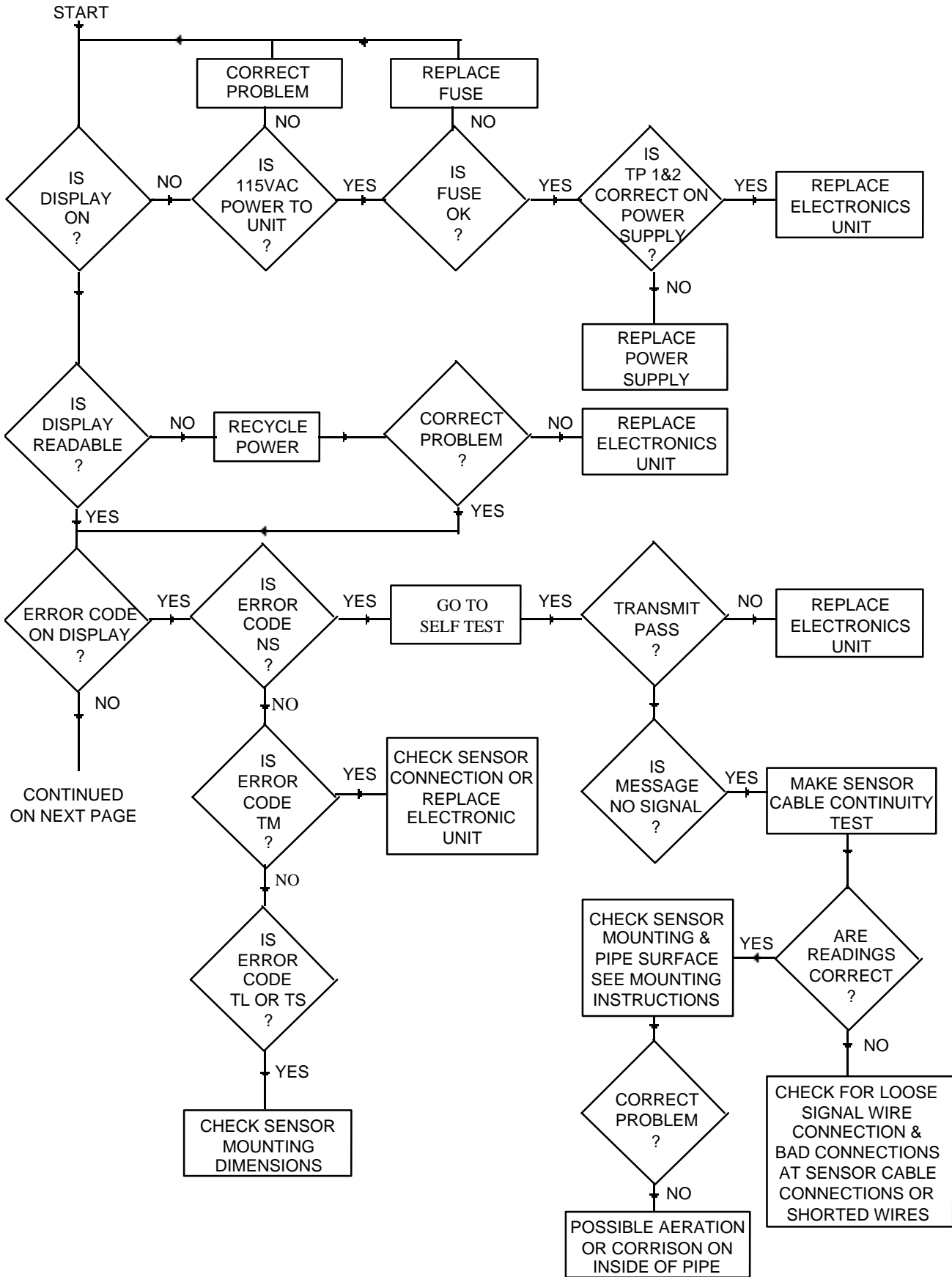
+14VDC - Connect the test leads to test points 1 and 2 on the power supply board. The voltage should read 14 VDC +/- 2 volts.

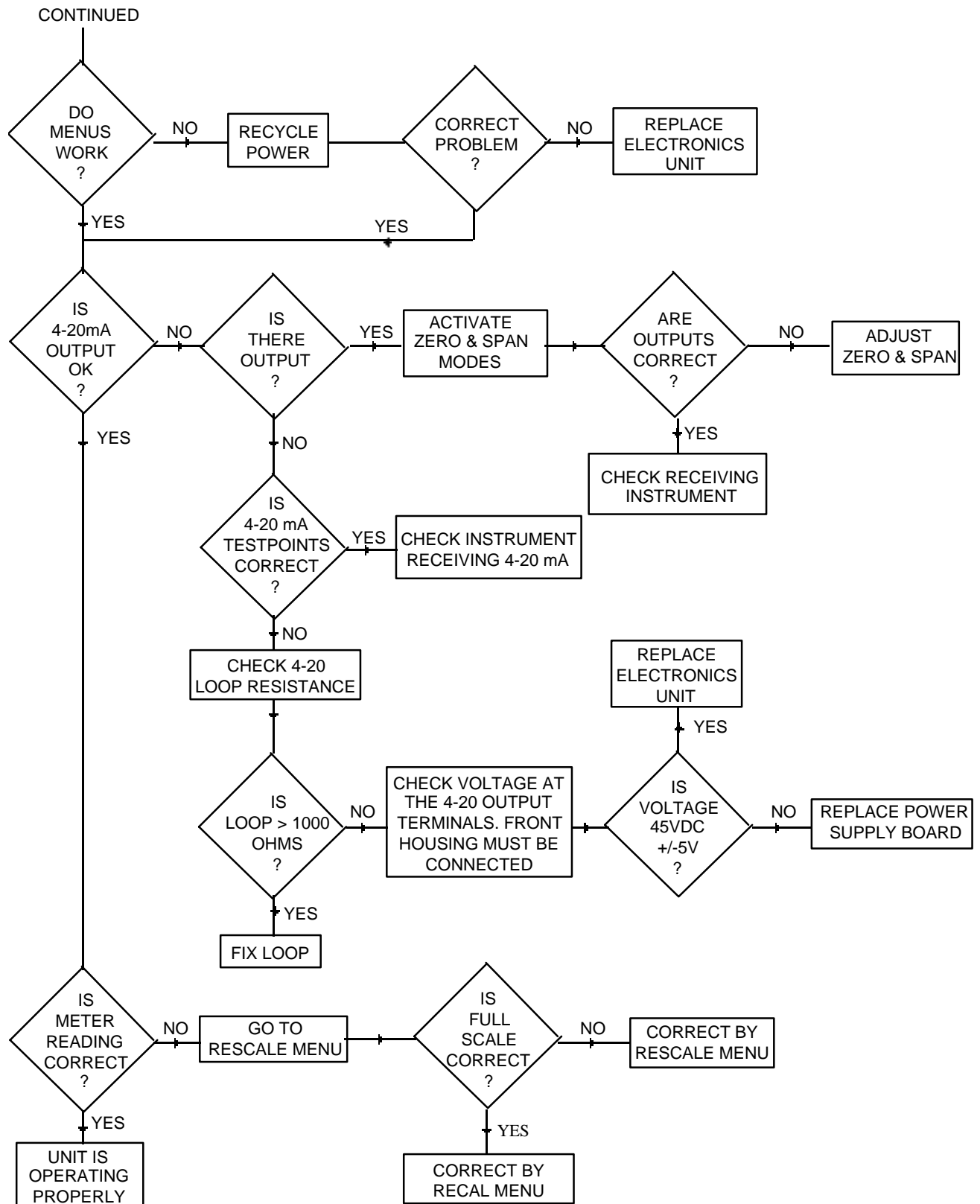
+40VDC - Connect the test leads to the test points 2 and 3 on the power supply board. The voltage should read 40 VDC +/- 1 volt.

-40VDC - Connect the test leads to the test points 2 and 4 on the power supply board.

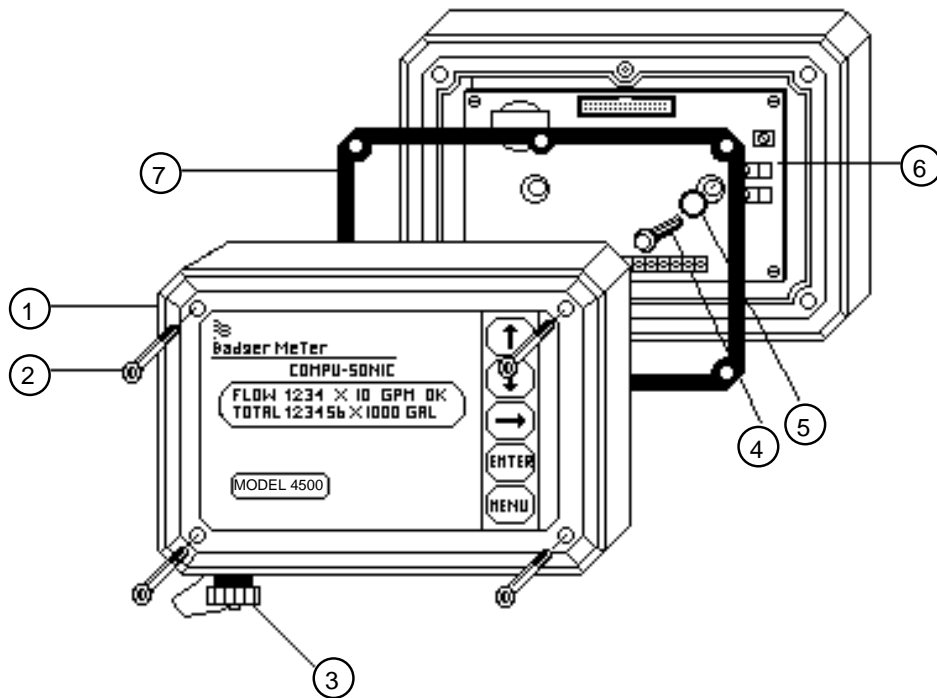
4-20 loop power - Connect the test leads to the test points 5 and 6 on the power supply board. The voltage should read 45 to 50 VDC when operating the meter on AC power.

TROUBLESHOOTING CHART





**ILLUSTRATED PARTS LIST
SERIES 4500 ENCLOSURE**



ITEM #	PART #	DESCRIPTION	QUANTITY
1	543563-9999	FRONT HOUSING W/ELECTRONICS	1
	543563-0001	MODEL 4500-12	
	543563-0002	MODEL 4500-6	
	543563-0003	MODEL 4500-3	
2	400003-0048	SCREW SCHCAP 10-32 X 2-1/2 LG SS	4
3	501153-0001	CAP SEALING	1
	501101-0001	CONNECTOR RECP 8 CKTS W/SQ-FLG	1
	400001-0025	SCREW PNH-S 4040 X 3/8 SS	4
4	400029-0002	SCREW HEXWSHRH 1/3-AB X .75 STL	2
	or 400022-0016	SCREW HEXWHRH 1/4-20 (ROLOK) ZN	2
5	490004	O-RING	2
6	151944-0001	AC POWER SUPPLY 117 VAC	1
	or 151944-0002	AC POWER SUPPLY 240 VAC	1
	160978-0004	FUSE 3AG 1/4A 250V	1
7	512310	GASKET	1

WARRANTY

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